THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 41. Thursday, December 19, 1929. No. 696.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of
THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.
Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

Institute of British Foundrymen.

DECEMBER 21.

Lancashire Branch (Junior Section):—Meeting at Manchester. Short Paper night.

JANUARY 4.

Lancashire Branch:—Ordinary meeting at Manchester. "Aluminium." Paper by N. C. Ashton.

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "The Influence of Manganese on Cast Iron." Paper by H. Forrest.

The Role of the Melting Plant.

At a joint meeting of the London Sections of the Institute of British Foundrymen and Institute of Metals, held last Thursday, Mr. D. F. Campbell and Mr. W. S. Gifford presented a very interesting Paper on "Melting Metals by Electricity." During the discussion the authors were asked point blank if all the furnaces described—arc, induction and high frequency—were commercial propositions. A very definite affirmative was given, and this answer provides the key to most metallurgical developments. There is no universally acceptable system of melting, and according to local conditions so will coal, coke, pulverised fuel, oil, gas and electricity continue to be used or find a new sphere. The crucible process will never be entirely superseded, because of its low cost of installation and elasticity; so, too, the cupola, with the added advantage of cheap operating costs. Again, round about the large iron and steel works, one cannot envisage any system of melting much cheaper than a mixture of blast-furnace and coke-oven gas. The one furnace which we do feel is doomed is the coal-fired reverberatory furnace. This must give place to oil, powdered fuel or gas firing, though there are districts where coal is so cheap, and the *modus operandi* so firmly established that the executives are still dubious about changing.

There are a few factors in furnace choosing that are often lost sight of by potential users, one of which was happily stressed in last Thursday night's lecture—that is, an increased output from a smaller unit. This can often be associated (without detriment to production) with lighter and cheaper handling tackle, and, maybe, absence of a chimney stack. Then the production of a small quantity with greater frequency often "gingers-up" production. It is almost axiomatic in works practice that the speed of the overhead travelling cranes sets the pace for the whole shop. So, too, the frequent production of casting metal helps rapid production by freeing more rapidly moulding-box plant, reducing the quantity of sand necessary, facilitating the organisation of auxiliary labour, and rendering possible the early detection and elimination of faults in quantity-produced castings. These factors can be demonstrated as being of the utmost importance and significance in ironfoundries where casting is virtually continuous.

Finally, with large melting units, there is to be associated labour conditions of the kind whereat the men work far too hard for a period and do practically nothing for a time. For ordinary ingot production this is an essential in the light of present knowledge, but, with the exception of the largest steel castings, mainly for marine work, the multiple-unit system, properly synchronised, is preferable.

Bridges and Other Matters.

A pleasing feature of our national life in these otherwise unsentimental days is the readiness to honour great men and prominent events when their anniversaries occur. As an example, we may cite the celebration in Glasgow of the Nielson Centenary—that is to say, the discovery of the hot-blast process in 1829. Before we say farewell to 1929, therefore, let us take this opportunity of recalling to our readers the fact that it is exactly one hundred and fifty years since the completion, in 1779, of the first important structure in cast iron that struck the public imagination. This was the bridge over the Severn, at the spot that has since become known as Ironbridge. To-day there are those among us who feel that it might with advantage have been called Castironbridge! Had the modern publicity expert made his appearance a little earlier, no doubt something of the kind would have been managed! Since 1779 a good deal of water has flowed under Ironbridge, and, considered from one point of view, a hundred and fifty years seems a long while. It is otherwise if we recall how much has been done during the period, and how vast a body of conservative tradition has been built up in the founding industry. The history of the iron-founding trade, save in isolated and localised instances, has not yet received its fair share of attention. But every founder with the slightest pretension to an understanding of his craft is aware of the main lines of its development. In particular he is aware, or should be aware, of the very short period which that history covers. Yet, if our history is short in lapse of time, it is long in extent of achievement—an achievement hardly to be rivalled in any other trade, and increasing all the time in pace and significance. It seems fitting on the occasion of this anniversary to point out that, if we have done so much in the past, there is every reason to anticipate that we will do still more in the future. Progress is cumulative; it does not work itself out, but increases in pace and magnitude. When we think how few generations have elapsed since that first iron bridge was thrown open, should we not also think how much another generation or so may live to see? Bearing in mind so strong a probability of further progress—we might almost say revolutionary progress—no man can afford to stand still. And, if inspiration be needed, surely there is no better place to seek it than in the past, and in the courageous way our ancestors faced and solved their problems, in spite of training and resources infinitely inferior to our own. What a flood of light is thrown on history when we ascertain the fact of such an human relationship as this, that Nielson's father was employed by Roebuck, the friend of Boulton and Watt, who left the Midlands to start the great Carron works in Scotland!

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Blue Skin.

To the Editor of The Foundry Trade Journal.

Sir,—There has been a considerable amount of controversy at various times *re* the "blue skin" on castings, and I have heard many different reasons given of how this comes about. Quite recently I heard of a prominent research man saying that the way to obtain this pleasing feature on castings was by using a certain brand of sand.

I would very much like to know if this is the accepted fact among foundrymen generally, as I have produced this blue skin with various kinds of sand, none of which were the kind mentioned by the research worker, and I am of the opinion that the sand used has nothing to do with the blue skin. I find that by removing the castings from the mould when black hot, it produces this blue skin.

This gives one the idea that the blue is caused by the chilling effect of bringing the castings suddenly into a cooler atmosphere.

I should like to know what was the general opinion of your readers.—Yours, etc.,

H. B. Roberts.

Chez Nous, Norris Road, Prescot,
December 11, 1929.

[We ourselves have always associated skin colour with cooling conditions which is related to the heat conductivity of the enclosing sand. A second factor is, of course, that the surface is oxidised. Another factor is the smoothness of the skin, which, again, is related to the moulding sand and the facing used.—Editor.]

British Steel Export Association.

CENTRALISED SELLING OF PLATES, SECTIONS AND JOISTS.

The Export Sales Committee representative of the makers of sections, joists and plates in the various producing areas, is to be superseded in the New Year by a new organisation, to be known as the British Steel Export Association. The Export Committee has now been working for about eighteen months past, and it has achieved a fair measure of success. The Committee holds meetings at regular intervals in London, working in conjunction with district sub-committees, and it reviews important foreign orders and authorises, where necessary, quotations at rates below the official export prices for plates, sections and joists quoted by the steel-makers. Its work will now be taken over by the Steel Export Association. As before, only large orders will come within the province of the Association, which will function under the management of Mr. Julian Piggott, of Messrs. David Colville & Sons, Limited, with a committee representative of the principal producing firms. The Association will be established in offices in Westminster by the New Year. Present arrangements provide for the continued existence of the Association over a period of three years, but it is possible that before the expiry of that period the Association will be converted into a definite trading concern. Meanwhile, it will act on Association lines, quoting a price for export orders and intimating to the buyer the firms which will undertake to execute the order at that figure.

H.M. Stationery Office has reprinted Provisional Air Ministry Aircraft Specification No. D.T.D. 39 for Magnesium Alloy Castings. The specific gravity of this alloy is between 1.80 and 1.83. The chemical composition specified is: Al, between 3.5 and 6.5; Zn, between 2.5 and 3.5; Mn, between 0.25 and 0.7; Cu, not more than 0.4; Pb, not more than 0.4; Sn, not more than 0.2 per cent., and Mg the remainder. Impurities: Fe, not more than 0.1, and Si, not more than 0.4 per cent. Mechanical tests are: Maximum stress, not less than 12 tons per sq. in., and elongation, not less than 6 per cent. The test samples are to be cast in a chill mould, and poured first from the same ladle of metal as the castings. The test samples shall be 1 in. in diameter and 7 to 9 in. long.

Third (Triennial) Empire Mining and Metallurgical Congress, South Africa, 1930.

The Third (Triennial) Empire Mining and Metallurgical Congress will be held in South Africa from March 24 to May 9, 1930, beginning and ending at Cape Town. A brochure has been prepared and forwarded to all members of the constituent bodies of the Empire Council of Mining and Metallurgical Institutions, giving detailed arrangements of the two proposed tours, and incorporating information which would be useful to members from overseas who contemplate taking part in the Congress. Reduced fares have been offered by several shipping companies. The cost of the tour, from date of arrival at Cape Town, will be £140 to £145, this being an inclusive charge for an itinerary covering 7,000 miles through the Union of South Africa and Southern and Northern Rhodesia. Travel will be by special train, which will cater for the greatest comfort and convenience of members.

An attractive programme has been drawn up, which embraces sessions in Cape Town, Johannesburg, Bulawayo and Durban, with visits to mines and works and places of historical interest and scenic beauty throughout the country. Important technical Papers dealing with different phases of mining, metallurgy and allied subjects will be presented and discussed. Local committees have been formed in each centre to be visited to ensure that the varied tastes of the members, including the ladies, will be catered for in social functions, sport, etc. South Africa is a country of absorbing interest, especially to technical men, and, considering the reasonable cost, the places to be visited, and the distance to be covered, this tour should commend itself to all. The fullest information may be obtained from The Secretary, Third (Triennial) Empire Mining and Metallurgical Congress, P.O. Box 4604, 100, Fox Street, Johannesburg, South Africa.

New Foundry Club Premises Opened.

The Social and Athletic Club of Messrs. Sidney Flavel & Company, Limited, Eagle Foundry, Leamington, held a smoking concert recently in the New Club, Grove Place, to celebrate the opening of the new premises. Mr. Percival Flavel, J.P., President of the Club and managing director of the firm, declared the Club officially open and conveyed a message for the chairman, Alderman Sidney Flavel, J.P., C.A., wishing the Club every success. A second concert was held last Thursday, and Mr. Roberts, the foundry manager, who occupied the chair, wished Alderman Sidney Flavel an early return to health. Mr. Sanderson, who has been with the company sixty years, was vice-chairman.

Structure of Cast Iron and Changes due to High Temperature.—A. Le Thomas, in a recent issue of "Comptes Rendus," of the French Academy, gives an account of an examination he made and the differences due to heat treatment he found in the behaviour of a series of 10 bars of cast iron (C 3.34, Si 1.51, Mn 0.57, S 0.07, P 0.27 per cent.) of diameters varying from 13.0 to 100.5 mm., but otherwise similar. The Brinell hardness, expansion due to a cycle reaching 850 deg., and amplitude and temperature (this last but slightly) of the Ar transformation, all steadily diminished as the thickness of the bars increased, whilst the effect of the fusion of the phosphorus eutectic was perceptible at a lower temperature (960 deg.) for a thin bar than (1,020 deg.) for a thick bar. The Ac point remained unchanged throughout, and the temperature of graphitisation after rising steadily to that of the Ac point for a bar of 30 mm. dia. thereafter remained constant. The conclusion he arrived at was that a more slowly cooling thick bar was more stable than a quicker cooling thin bar.

Random Shots.

You should really feel very grateful to me this week. I had just got this column all nicely ready to send off to the editor when I happened to glance at the calendar, and discovered that, if I didn't take this opportunity to wish you all a happy Christmas, it would have to go by default, since Christmas very awkwardly comes on a Wednesday this year. So may I wish all my readers a very happy Christmas and the best of good trade in the New Year?

* * *

The recent London dinner set me to speculating a little on what might be called the personal aspect of the foundry trade. With the exception of the Annual Convention, all accounts and reports of activities in our midst are of the most formal and impersonal description. Yet the merest babe in the foundry world knows that personalities abound there as elsewhere—rather more so, in fact—personalities formidable, amusing, endearing. Why must they be lost for fifty-one weeks out of the fifty-two in the abstract formalism of "Mr. So-and-So, delivering the presidential address of the East Devon and Cornwall Branch, said that what the foundry trade needed was, etc., etc., etc."? Or, again, "Mr. Such-and-Such then proposed a vote of thanks to the lecturer for his interesting remarks on the improvement of language in the foundry"!

* * *

The daily Press likewise conforms to regulations of this sort, but gets over the difficulty—knowing that such reports are apt to be read a trifle hastily—by employing a gossip-writer to fill in the gaps in another part of the paper. Myself, I am perfectly willing to act in some such capacity, but there are obstacles. The first is the impossibility—at the present stage in human history and achievement—of being in three places at once. Oh, yes; I daresay you've noticed that I do manage it now and then, but it leaves me utterly exhausted, strong though I am, and in the ordinary way I have to decide carefully which events deserve the honour of my presence and which will have to do without. The gossip-writers, you see, don't write their own gossip—not all of it, that is. They piece it together paragraph by paragraph, from more or less authenticated contributions, and often, I believe, the signature is about the only effort they need to make! Any offers? It must be an excellent way of settling old scores, though I daresay a preliminary study of the law of libel is an advantage!

* * *

The second difficulty is that I am rather afraid that foundrymen's meetings would not make quite such picturesque reading as society weddings and charity matinées. I could say, I suppose, that "Mr. What's-His-Name, wearing a strikingly up-to-the-minute dress suit, rose to reply"; and I could assure you that, on a given day, "Mr. Somebody Else appeared to be setting a new and excellent fashion of spats in the foundry." I could remark that "the speaker was closely related to the chairman and in a most romantic way, because the speaker's sister's husband's brother had married the chairman's son's mother-in-law's sister." Not nearly so inspiring as cloth-of-gold wedding costumes—isn't that what they wear nowadays?—and third cousins three times removed to the Grand Ducal house of Ruritania!

* * *

A University education may be a passport to life, but to be valid it has to be visa'd by experience.

Marksman.

Electric Furnaces for Steel Melting.*

By N. Ryland Davis, M.A., and C. R. Burch, B.A.

In these days of the "Grid" and the Central Electricity Board it would seem tactful to think first in terms of electrical energy whenever we want to do anything at all, but it is not immediately clear that a process which starts by wasting 75 per cent. of the available energy can possibly form a basis for the economic application of heat. The original appearance of electric furnaces can be attributed to the blind optimism which distinguishes the pioneer from his saner brethren, but when, after 20 years, we find that the contagion has spread and that millions of kw. are consumed in heating metal, we must either conclude that the millennium has been reached, and that Mammon has been sacrificed to an ideal, or that electric heating actually conveys some tangible advantage.

If we were to look into steel melting practice, no more antiquated and inefficient method of melting could be found than the crucible process—a process with a thermal efficiency of 4 per cent. Suppose now that we have the best furnace that electrical engineering has produced and supply it with energy from a benevolent corporation at a farthing a unit, then we could just, and only just, compete on power costs with this mediæval relic. The contribution to running expenses formed by interest and depreciation represents only a small part of the running expenses, and even were an electric furnace supplied for nothing, the economics of the situation would not be sensibly altered. There are many considerations which might influence the situation in favour of the electric furnace, and among these are labour, cost of refractories, quality of the product and cost of raw materials.

Classification of Electric Furnaces.

It is not possible to make a general comparison between electric furnaces and fuel-fired furnaces, because the properties of the various types of each kind are so entirely different, but there are four main classes of electric furnace which can be compared, in a rough sort of way, with their prototypes of the prior art.

First there is the type of furnace which makes use of independent resistance elements, in which electrical energy is dissipated, the charge itself being heated by radiation and convection. Such furnaces have never become very popular for melting, their chief applications being the comparatively low temperature operations of annealing.

In the second form of furnace the metal itself, confined in a channel of suitable shape, forms the resistor element. This channel forms the secondary of a transformer. In these circumstances the attainable temperature is limited either by the boiling point of the molten charge or by the refractory in which the channel is made. The latter limitation has prevailed up to the present and the furnace is used almost entirely for melting brass. It is the most efficient electric furnace ever made. Melting 60 : 40 brass the power consumption is of the order of 240 kw.-hr. per ton, and when convenience, repairs, labour costs, quality of the product and metal losses are taken into account, is said to show a saving of nearly £1 per ton over the older methods. A particular arrangement of this type of furnace invented by James Wyatt is almost universally employed. It is worthy of note that over 50 per cent. of the sheet brass made in America is melted in such furnaces, and in Great Britain over half a million pounds of brass are melted weekly in this type of furnace.

The comparison between the Ajax-Wyatt furnace and non-ferrous fuel-fired furnaces is quite straightforward, but it is quite otherwise if one attempts to compare the arc-furnace with previously known methods of melting and refining steel, as a moment's consideration will show.

Consider first the manufacture of mild steel by the basic open-hearth process. The cost of the finished product ranges round £6 to £7 per ton. The melting cost is of the order of 30s., and no considerations of quality or convenience can be adduced which would justify an addition to the price. In this field, which represents at the moment 99 per cent. of the world's steel production—some hundred million tons per annum—the arc furnace is definitely excluded on the score of cost alone.

Now consider stainless steel (15 to 20 per cent. chromium). Originally this was made in very small quantities in the crucible, the products being made into fancy goods which sold at so high a price that melting costs even of £20 per ton were not prohibitive. As an engineering

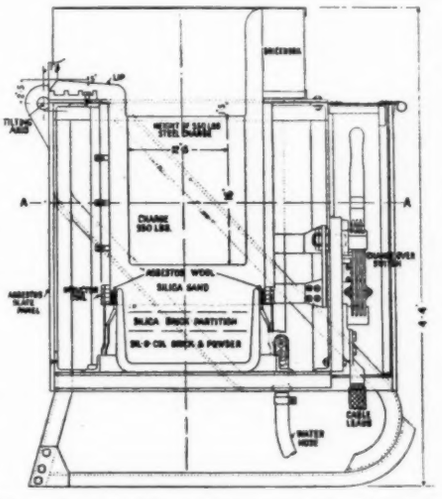


FIG. 1.—SECTION THROUGH ¼-TON INDUCTOR FURNACE, SHOWING WATER-COOLED COIL IN STEEL FRAMEWORK.

demand grew and larger ingots were called for, the arc furnace was pressed into service. This enabled ingots to be made up to 20 tons, and reduced the melting costs by perhaps £15 per ton—about 10 per cent. of the selling price. With the present price of ferro-chrome, and using the present process, even if it were possible to make stainless steel in the open-hearth, a saving of not much more than 1 per cent. would result. It may be expected, then, that the arc will hold its sway in this field, until the other contributions to the cost of manufacture have been reduced to such an extent that the melting cost again becomes significant. As the demand arises for larger and larger ingots of chromium steels, it is not at all clear whether the demand will be met by the development of larger arcs, or by a more determined attack on the problem of melting chromium alloys in the open-hearth.

Even if all alloy steels were made in the open-hearth, as indeed a great many are to-day, there would still be difficulty in disposing of turnings and borings which can only be charged into the open-hearth in small quantities. The arc displays considerable avidity for this type of charge, and in making alloy steels from turnings and borings will always compete with the open-hearth making the same alloy from virgin metal.

Regarding the quality of steels produced in various ways, experts differ as to whether better steel can be made in the arc or in the open-hearth, but there is very little doubt that steel made in the crucible is better than either. Where small quantities of the best possible steel are required and price is no object, the crucible process would always have preference, despite the fact that the melting cost is three or four times as great. In the case of 35 per cent. cobalt magnet steel, the price of the raw material alone is over £300 per ton: the material is usually required in the form of small castings and there is thus no incentive to risk the development of a process for melting £1,000 worth of metal in one charge in order to achieve a possible saving of 2 or 3 per cent. in the price of a finished product, which must, in general, be of inferior quality. While the arc furnace has succeeded in making serious inroads into the field of crucible furnaces, it could never have completely supplanted them. During the last few years an electric furnace has been introduced in which it is possible to make steel as good as, if not better than, crucible steel, and this, moreover, at a cost comparable with melting in the arc. This furnace, a form of induction furnace, has, in fact, removed the last argument which could be adduced in favour of the crucible process.

It has influenced the economics of alloy steel production in three ways. First, it has reduced the cost of melting high-quality alloy steels by about £10 per ton and permits the visualisation of the possibility of crucible-quality ingots weighing several tons. Second, it provides, at the present ruling prices, a method of melting certain low-carbon alloy scrap more economically than with the arc, in which it is difficult to avoid a carbon increment without loss of chromium. Finally, it has rendered possible the production of carbon-free alloys, of which "permalloy" is perhaps the most important example. A furnace which has achieved such success and raised such high hopes within the comparatively short space of two years of commercial operation deserves more than passing notice.

Induction Furnaces.

For years the engineer has deplored the fact that when a piece of metal is placed in an alternating magnetic field it gets hot, but only quite recently has serious attention been given to the problem of designing large-scale furnaces working by virtue of this fact. The readiest way of applying this principle is to take a crucible and place it inside a coil carrying alternating current, and this, indeed, is what is done.

Following in the footsteps of Dr. Northrup and with suitable metallurgical guidance, the electrical engineer will take a motor-generator, some condensers and switchgear, and evolve a furnace such as is shown in section in Fig. 1. He will postulate that 160 kw. will melt the charge in less than an hour, but that 50 cycles A.C. will not do: the furnace will have to be supplied with current at some frequency ranging from 500 to 2,000 cycles. The power factor will be poor—of the order of 0.15—and it will be economical to supply about 1,000 k.v.a. of condensers, so that the generator will operate at unity power factor. He will point out that there will be considerable mechanical forces operating on the liquid bath, which will well up in the middle to a height of perhaps 2 in., flowing outwards and down at the sides. He might venture to express the opinion that such an electric fountain would not matter, but he would certainly leave any prediction of metallurgical performance to the steelmaker.

Some four years ago the authors consulted metallurgical opinion regarding a 10-lb. laboratory induction furnace which they proposed to make. They were assured that it was desirable to be able to lift out the crucible for pouring, as only in this way would it be possible to simulate the teemer's skill which was regarded as so important a part of crucible practice. To pour through a funnel and thus ensure hitting the bottom of the mould was criticised on the score of chilling the metal, and they were not to be allowed to superheat the metal, on the somewhat

* A Paper read before the Manchester Association of Engineers on December 13.

mysterious grounds that this would "burn" it. No doubt the pioneer, Dr. Northrup, was met with just such disconcerting suggestions.

The authors constructed, not only a 10-lb. furnace, but a ¼-ton furnace, and invited the metallurgical world to come and see it. Steel melters still maintained that it was essential to hold the metal molten for a period of an hour or so, the argument apparently being that only in these circumstances could the gas bubbles and slag particles be expected to rise to the surface, and a "dirty" ingot be avoided. Had this proved true, and even had it been possible, without endangering the refractories, to provide the superheat (about 300 deg. C.) necessary to keep the metal molten for an hour, the resultant halving of output which would nearly double the melting costs would have removed the principal competitive advantage in comparison with the older process and might even have brought the development to an end. It was feared that the fountain would disperse particles of slag throughout the mass and that only a long period of quiescence would allow of their removal. Actually, when the furnace is in operation, one can see particles of foreign matter appearing from time to time on the surface of the metal, and being carried by the circulation towards the sides, where they adhere to a gradually-forming ring of molten slag. This, then, is the reason why perfectly clean metal can be poured from the induction furnace almost as soon as the metal is molten.

Apart from these differences of technique, the outstanding physical difference between this and any other process of steel manufacture is that no attempt is made to prevent a fairly free access of air to the charge during the whole of the operation. It is found that if iron containing only carbon is melted in air a steady evolution of gas takes place from the molten bath and a further evolution occurs during solidification. If the bath is maintained liquid, the gas evolution continues until the carbon content falls to a very low value (below 0.05 per cent.). The metal, however, is not quiet in the mould. It is essential in all but the poorest quality steel that blowholes due to gas evolution be avoided. The metal must be quiet in the mould. If, now, carbon-free iron is melted in air, it is quiet both in the bath and in the mould. The gas evolved must, therefore, be the result of a reaction between the carbon and the iron oxide in the bath. If to the molten bath there is added some material which has more avidity for oxygen than the carbon, the oxides in the bath are eliminated and evolution of gas will cease.

When steel is melted in the crucible process, although there is very little oxide present, the metal must be supposed to be saturated with carbon monoxide, and therefore the instant it has been removed from the pit-fire it is identical in condition and composition with a melt made in air, to which just enough deoxidiser has been added to remove the dissolved iron oxide. Both melts would evolve CO during solidification, and a further addition of deoxidiser is necessary to remove the CO present, and any oxygen which may be absorbed from the air during pouring. Since the reaction between deoxidiser and CO is incomplete this can only be achieved by having an excess of deoxidiser present, and the excess must be the same in both cases. Although it is necessary to use more deoxidiser in the induction furnace than in the crucible process, because of the initial oxidation, there is no reason to suppose that any greater quantity will appear in the final ingot. Dr. M'Cance has calculated the excess of deoxidiser corresponding to any carbon concentration and this—the minimum quantity—must be present in the ingot for equilibrium. Thus, if one deoxidises a 0.5 per cent. carbon steel with ferro-silicon, the final ingot will tend to be wild, unless it contains at least 0.15 per cent. of silicon.

It was suggested that if the metal was superheated considerably its quality would be seriously impaired. Had this proved true, it would have detracted considerably from the flexibility of the furnace when used to make small castings, which must be poured from a ladle, an operation taking a considerable time. That the metal should remain hot in the ladle for sufficient time requires a considerable superheat. Such practice, however, is now standard in steelworks. Fear for the refractory alone dictates the maximum temperature to which the charge can be raised, and so far as is known metal has never been harmed in the induction furnace by superheat.

However attractive a furnace may appear judged by the quality of its products and the cost of operation, it must lose much of its appeal if its safety or its reliability can be called in question.

One may well be excused apprehensions regarding a device in which a quarter of a ton of molten steel is surrounded by a water-cooled metal coil, the whole being contained in a wooden box, and, in fact, it was some time before one learnt to regard with equanimity the prospect of the metal finding its way through the lining to the coil, or contemplated a cracked crucible with calm. However, in one case the furnace bottom was not properly made up, and about half the sand backing leaked out at the bottom. The crucible cracked and some 30 or 40 lbs. of metal replaced the lagging, solidifying against the coil. The remaining metal in the pot was poured and no damage of any sort was done either to the coil or to the furnace.

Engineers could and did predict the electrical performance of an induction furnace with some considerable accuracy, and no experience born of practice has modified the engineering aspect of the problem. One could to-day design with confidence a 5- or even 10-ton furnace. Electrically and economically it would compete with the arc as a melting unit. It is doubtful whether further experiments on the ¼-ton scale will provide the metallurgist with any surer basis on which to assess its metallurgical potentialities, and in fact only two stumbling-blocks remain in the path of development; courage on the one side, and on the other, cash.

Book Review.

Gemeinfassliche Darstellung des Eisenhuttenwesens (A General Survey of the Iron and Steel Industries). 13th edition. Published under the auspices of the Verein Deutscher Eisenhüttenleute, by the Verlag Stahleisen m.b.H., 27, Breitestrasse, Düsseldorf. Price 15 mks., plus postage.

This remarkable compendium of the German iron and steel industry is one of the most interesting books that ever reaches our hands. It contains no less than 728 pages, 128 illustrations and a mass of tabular matter.

The fact that it has reached its 13th edition speaks well for its popularity and general worth. The book is so comprehensive that some details are necessary for those who are not familiar with previous editions. The first section of the book can be clearly shown by a reference to page 22, wherein, by a diagram, illustrations of furnaces are imprinted against date of invention, with lines showing their interconnection. Naturally there is included a chronological list of metallurgical inventions and development. It is interesting to note that in this table Wilkinson is credited with having installed a steam-driven rolling-mill at Brydley (Bradley ?), yet on page 154, he is referred to as the inventor of the cupola.

The second section deals with the raw materials for ironworks—the irons, other than ores, coal and coke and refractory materials, This is followed by a long and comprehensive chapter on the blast furnace and its working, whilst the development of the steel furnaces is similarly dealt with in Chapter IV. Herein the cementation, crucible, Bessemer, Siemens and electric and even direct process are reviewed. Naturally, Chapter V, which deals with foundry practice, has the most interest for our readers. Just 130 pages are devoted to its consideration. Now this is not a book in which to search for profound technical information—it is a review of developments and shows the industry as it stands to-day. For instance, the provision of liquid iron is dealt with in four pages, and this has to take care of air, crucible, electric and cupola-furnace practice. Yet, in justice, one must admit the essentials are given, for instance, the various forms of sandslingers are indicated, whilst the use of high-pressure water for fettling is referred to. We have been impressed throughout that the book is definitely up to date. This section also includes the working of iron and steel products into articles of commerce.

Chapter VI is devoted to the testing of raw, semi and finished products, and includes also the iron-carbon system, heat-treatment, influence of cold working and analogous studies. The technical section of the book finishes with a review of such subjects as site selection, heat and power utilisation of blast-furnace and coke-oven gas. In this connection we would specially commend our readers' attention to the diagram on page 269, wherein the power distribution and materials movement in an ideal metallurgical establishment is shown. In the left-hand top corner a sketch indicates the colliery-surface plant, with a theoretical 100 tons of coal leaving. At the right-hand top corner is the coke-oven plant, with 50-10^6 kilo calories of gas and 75 tons of coke leaving. A little lower is the iron-ore stock yard, with 150 tons of that material entering the blast furnace. So the process continues, until a small train leaves the rolling-mill with plates and sections. This, we assert, should be redrafted, translated framed and prominently displayed in every metallurgical establishment, whether academic or industrial, interested in the subject of iron and steel production.

Finally, the training of the personnel for the industry is detailed, together with the available German literature on the subjects covered.

The second half of the book is commercial. After a short general survey of the industry, the vital statistics gathered from the world over are intelligently set out. Miles of railway lines constructed, registered shipping tonnage, non-ferrous metal production, coal output, coke production, scrap consumption by the industry, iron ore output, pig-iron production, steel production are some of the outstanding features presented for comparison. Detailed reviews are then presented of each country's position in the industry. Probably the most important part of the whole volume is Chapter III of this second part. It outlines the make-up of the German iron and steel industry, its resources, its works and its cartels, both national and international relations through other cartels. This is followed by a detailed statement of the actual associations which exist in Germany.

Chapter V sets out the methods of marketing iron ore, scrap and iron, giving the names of the concerns handling the material, whilst the next section details by tables the actual market prices.

Chapter VII treats of the Customs duties in respect to iron and steel goods, and is followed by one on the relation to the railways and canals. After a chapter devoted to trade-union matters, the whole position of the workers and their training is also considered. The final chapter treats of social questions, staffing, the relationship of the industry to art and the like. Finally, there is a complete directory of the German iron, steel and ferrous-foundry industries, which occupy some 70 odd pages. To collect the same information anent the British iron and steel industry, one would just have to fill a large bookcase. It furnishes just one more instance of the advantage of a really strong group of employers' federations.

I.B.F. London Branch Dinner.

THE INDUSTRIAL RENAISSANCE.

The annual dinner of the London Branch of the Institute, held at the Engineers' Club, Coventry Street, W.1, on Friday, December 6, was, as usual, a jolly and successful function, under the chairmanship of the jovial Branch-President (Mr. J. W. Gardom). The principal guests of the evening were Sir William J. Larke, K.B.E. (Director of the Federation of Iron and Steel Manufacturers), and Professor Sir Harold Carpenter, Kt., M.A., Ph.D., A.R.S.M., F.R.S. Others present included Mr. Barrington Hooper, C.B.E. (Director, FOUNDRY TRADE JOURNAL), Mr. J. G. Pearce (Director, British Cast Iron Research Association), Mr. J. Ellis and Mr. V. C. Faulkner (Past-Presidents of the Institute), Mr. W. B. Lake, Mr. H. O. Slater and Mr. A. R. Bartlett (Past-Branch-Presidents), Mr. E. Ferris, Mr. D. T. Mattison, Mr. J. H. Nelson, Mr. A. F. Gibbs, Mr. H. C. Dews and Mr. H. G. Sommerfield (hon. secretary and treasurer of the Branch).

It was regretted that, owing to illness, Mr. Wesley Lambert (President of the Institute and a Past-President of the London Branch) was prevented from attending. He sent a telegram regretting his inability to attend, and expressing his best wishes for a successful evening.

Letters regretting their inability to attend were received from Sir John Dewrance, Sir Hugo Hirst, Mr. John Craig (Colville's, Glasgow), Mr. E. J. Fox (Stanton Company), Mr. H. Winterton (President, F.T.E. and S. Association), Mr. John Cameron (Past-President of the Institute), Mr. Patterson (Messrs. J. E. Hall, Dartford), Mr. Deschamps, Messrs. Kryn and Lahy, Mr. Kenneth Bridges, Mr. J. M. Primrose (Falkirk), Mr. Colin Presswood, Mr. J. McNeil and Mr. H. Beeney.

Foundry Education.

The loyal toast having been duly honoured,

SIR WILLIAM LARKE proposed "The Institute of British Foundrymen." In the first place, he said, he had learned with great pleasure that the foundry industry was really busy; he was particularly delighted to hear that, because he represented an industry which looked to the founders to make it busy in turn. Those engaged in the iron and steel industry, in spite of their difficulties, were still optimists. Referring to the appointment by the Institute of a committee to consider the curriculum for the education and training of apprentices with a view to their passing an examination giving them a standard of qualifications in the technique of the industry, he said he hoped this work would be brought to such a successful conclusion that all the technical educational institutions throughout the country would accept that curriculum and would allow the examinations to be taken in their centres, and that, when the certificates were granted, they would be accepted by the industry as real certificates of the technical ability of the holders. If that stage were arrived at, the industry would attract to it some of the best and brightest of those who were looking for careers.

Defeatist Attitude of External Industrial Critics.

Industrial depression such as we had suffered, he continued, was often attributed to the inefficiency of industry and the industrialists, but it was not the result of inefficiency; on the contrary, inefficiency, where it existed, was the very natural result of depression. He hoped that all industrialists would deprecate and rebut the suggestions so loosely made, frequently in the Press, and nearly always by those who had no connection whatever with industry and knew nothing about it, that the industrial depression would pass if only the industrialists would bestir themselves. He would point out that the greatest stimulant to human endeavour was self-preservation; did anyone really think that the industrialists would not remedy the depression to-morrow if they could? We had made a great fight, as was evidenced by the manner in which we had discharged our post-war obligations. We should pull through, but he urged strongly that loose criticism of the kind to which he had referred was a form of defeatism which was doing infinite and incalculable harm abroad. If we wished to criticise ourselves within the family, then let us keep it within the family; we knew how to give and take criticism, and how to benefit by it.

The Open Shop for Inspection.

One of the greatest functions which a body such as the Institute of British Foundrymen could perform was that function of giving opportunity for mutual and friendly criticism with a view to advancing the technical efficiency of our industries. He understood, and he was glad to know it—indeed, he had intended to suggest it with some emphasis—that generally throughout the foundry industry the policy of the open shop to competitors was adopted. Such a policy provided the greatest possible stimulus to improving the standard of efficiency throughout the industry. Thirty years ago he had preached this gospel in the works with which he had been connected at that time, and where occasionally a new process was developed and brought to a successful conclusion, but those who were interested in those developments had thought it desirable to retain their knowledge for themselves. He had pointed out to them that that policy was entirely wrong, that by its adoption they would never contribute to the knowledge of their industry anything approaching the debt they owed to those who had gone before, and neither could they, in anything they developed themselves, gain so much that they would not gain more eventually by having placed at their disposal the experience of the rest of the industry in return for the knowledge which they could give to it. That function of spreading knowledge throughout the industry was one which the Institute should, and did, perform, and he personally had no doubt as to the ultimate recovery of British industry. The question arose as to how long industrial depression need last, and it was up to us all to see that the general depression in industry lasted as short a time as possible. We were all striving to effect a recovery. The fact that the foundry industry was active and busy he regarded as a precursor of a general revival of the industries which were the customers of the foundry industry, and he hoped that the iron and steel industry, of which the founders were customers, would again become fully active. He would indulge in a little advertising by urging them all to "buy British and employ British labour." (Hear, hear.)

The toast needed no commendation, and he invited the gathering to drink to the prosperity of the Institute, its development, its expansion, its increased usefulness, and, above all, the great inspiration that he hoped it would provide for the younger generation upon whose shoulders the leadership of the industry would in due course fall. In the regrettable absence of Mr. Lambert, he coupled with the toast the name of Mr. V. C. Faulkner, a Past-President of the Institute, and one of the best and most inspiring foundrymen of all.

Progress in National Examinations.

MR. FAULKNER responded. Referring, in the first place, to Mr. Lambert, he said it was particularly distressing to a man of such energy, and one who had suffered so very little illness throughout his life, to be confined to his house. On the telephone that afternoon he had asked him (Mr. Faulkner) to emphasise particularly the work of the Institute's committee—on which they both served—which was dealing with the education of foundrymen. It could now be revealed that the committee was considering approaching the Institution of Mechanical Engineers to arrange for the examination of the young men of the foundry industry. It might be asked why the Institute of British Foundrymen, which was one of the few institutions in Great Britain possessing a Royal Charter, should go to the Institution of Mechanical Engineers for help in this matter; he could assure anyone who might ask such a question, however, that that was not to the detriment of the Institute. The Institution of Mechanical Engineers had in existence an examining organisation, and helped other institutions in a similar way. It was also more than possible that the committee might also approach the City and Guilds Technical Institute, which was specially placed, with Government sanction, to conduct examinations for the ordinary apprentice entrants to industry. He believed that the Institute, by attaching itself to those two national bodies, would create for the foundry industry a status which it had not enjoyed in the past.

In expressing a hearty welcome to Prof. Sir Harold Carpenter, Mr. Faulkner recalled that the first occasion on which he had ever addressed a meeting of the Institute of British Foundrymen was one on which Prof. Carpenter was addressing a Branch meeting in Sheffield, about twenty years ago. It was with peculiar sense of delight, therefore, that he welcomed Sir Harold to this annual dinner of the London Branch.

£26,000,000 Buying Capacity.

Commenting on Sir William Larke's reference to the iron and steel industry, he said that certainly the output of iron had become less than it was previously, but that was probably due to the disappearance of the Bessemer process and to the fact that more scrap steel is used to-day than was used previously in steelmaking; really, the steel industry was not so badly off, however, as Sir William appeared to have indicated. With regard to solving the problem of industrial depression, he said there was something in rationalisation. He was annoyed frequently by people who suggested that the various firms should send their representatives to all parts of the world to seek new markets. It was obvious that that could not be done by the individual concerns, and it was also obvious that it was not necessary. What was needed was co-operation, so that one representative could represent fifty concerns in any one part of the world, and only by such a scheme they could afford to appoint such representatives. The politicians seemed to think that industry had money to burn. When the concerns in Sheffield were paying in local taxation the equivalent of about 12s. per ton on every ingot they made, how could they afford to send representatives all over the world? The politicians had ignored the foundry industry in the matter of legislation, yet its buying capacity was, at a minimum, 26 millions sterling per annum, and in that respect it compared favourably with all the other industries which had had legislation oriented specially for their benefit.

Activities of the London Branch.

PROFESSOR SIR HAROLD CARPENTER, proposing the toast of "The London Branch and its President," said he understood that the London Branch was one of the strongest of the local branches. He was particularly interested to know that the Branch had a junior section; it was very important to provide for the instruction of the younger members of the industry, for, after all, ultimately they would carry on the work of their present seniors, and one could not

emphasise too strongly the importance of the work of that section. He had also learned that the London Branch had provided three Presidents of the Institute—Mr. Ellis, Mr. Faulkner and Mr. Lambert. Another point of importance was the fact that the Branch arranged joint meetings with the London Local Section of the Institute of Metals. It was a mistake for two such bodies to work in watertight compartments, and he hoped that the custom of holding joint meetings would continue. Still another very well conceived custom was that of arranging international conferences, as the result of which British foundrymen were brought into touch with all the best technical developments of other countries, which we could not afford to be independent of.

Foundry Research Work.

For the last four years he had been associated—as also had Sir William Larke, at any rate for the last three years—with the Government organisation for the assistance of industry in regard to research. For the last two years he had been chairman of the committee in question, and in that capacity he had been brought specially into touch with the work of nineteen research associations. One of the best things the Institute of British Foundrymen had done was to found the British Cast Iron Research Association. That body had not had a very happy beginning; it had taken it some years to get going on the right lines, but to-day, under the guidance of Mr. J. G. Pearce (its Director and Secretary), and with the assistance of a small but very good scientific staff, it is doing some of the best work of any of the research associations in this country. He was particularly glad to pay his tribute to that work. There was nothing pretentious about it; it was very efficiently organised, and the Governing Council were convinced that the country was getting very good value for the money spent by that Association. He pointed out, however, that, although there were between 3,000 and 4,000 iron foundries in this country, he did not think that more than about 20 per cent. were contributing to the funds of that Association.

Mr. Pearce: It is about 10 per cent.

Professor Sir Harold Carpenter commented that that, of course, was a very regrettable feature. The unit size of the foundries was very small, and it seemed to him—he was not suggesting this, but was merely saying it—that the work would have been very much easier if there had been a smaller number of larger units, each one having a responsible metallurgist advising it, and who would have been able to interpret the work of the Association, because all this work was of no use unless the results of it could be interpreted by the men confronted with the problems of the industry itself.

An American Experience.

Referring to the importance of proper scientific education for industry, and the attitude which sometimes was adopted towards education and educationists, Sir Harold related an experience he had had in America when visiting a certain works. After some conversation the manager of that works had said to him: "You seem to have your head on your shoulders; why don't you get out of education and do something?" Sir Harold had replied: "I suppose you agree that your industry has a scientific basis, and that if you are to carry it on efficiently you must have well-trained students coming from the universities and technical colleges?" The manager had agreed, and said that he did get them. Sir Harold had continued: "You say that all the best young men get into industry and make good money; that means that those who are left at the universities to train students are not the best men, and in time you will have an inferior grade of men on your staffs. Do you think that third-class professors can train first-class students?" The reply was: "By gad, I hadn't thought of that; I reckon you've got me." (Laughter.) After that, said Sir Harold, he would rather be a Professor in England than in America.

The Manchester University's Contribution to Metallurgy.

Coming to the personal part of the toast, Sir Harold recalled that some 23 years ago the University of Manchester had founded a Professorship of Metallurgy, and he had had the honour of being the first occupant of the Chair. In time he had secured the services of one demonstrator, one student and one laboratory boy. His demonstrator was the present Professor Edwards, (Principal of University College, Swansea, a man whose work in metallurgy was known all over the world); his first student was later Professor Andrew (Professor of Metallurgy at the Royal Technical College, Glasgow); and his first laboratory assistant was Mr. Gardom, now President of the London Branch of the Institute of British Foundrymen. (Applause.) Sir Harold said he was proud of Mr. Gardom's record, and was not ashamed to say so, for it was a remarkable record. He had very soon become skilful in grinding and polishing metals, and had rendered great assistance in the work done in that Department. Since that time, however, he had left the paths of metallurgy to some extent, and his job at the moment was to see that 366 men did what he told them to do. In the early days he had had to do what he (Sir Harold) told him to do, and he had done it very well. He had had a little sanctum of his own—a dark little hole, with no ventilation—and had fitted it up in a most ingenious way with all sorts of contrivances for carrying out experiments. Even in those days he had had in him the making of the man he had since become. His election to the Presidency of the London Branch was an indication of what his colleagues thought of his work and of him as a man; after all, a man did not reach such a position unless he had not only ability, but personality. In him the Branch had a first-class President, possessing a fine knowledge of the industry, and who enjoyed the respect and affection of all. The toast was honoured with enthusiasm, and the President was accorded musical honours.

A Wide Appeal.

The Branch-President, on rising to respond to the toast, was again greeted with loud applause. In thanking the speakers for their kind remarks with regard to the London Branch, he said it had had some very nice things said about it from time to time, and on this occasion still more pleasant things had been said. It was good to be appreciated, but when one knew, as he knew, that all the kindly things said of the Branch were deserved, then it was easy to say with all sincerity "Thank you." The Branch was part of an Institute which, though in many respects similar to other Institutes, still had many distinctions which made it entirely different and the only one of its kind. Its membership covered not only all grades of workmen in the foundry industry—the apprentice, moulder, foreman, manager, managing director and foundry owner—but also included mechanical, production and electrical engineers, technicians, scientists, buyers and salesmen. The Branch had an independently-run Junior Section, and he believed the Institute was the pioneer in the running of Branches successfully. It had the most inspiring and progressive crest, representing "Science Hand in Hand with Labour."

It was not surprising, therefore, that the subjects discussed at its meetings should cover such a wide field as to include the training of workers, the betterment of working conditions, applied science, management, costing, transport and the obtaining of new markets for the products of the foundry. There had been differences of opinion, of course, and it was quite natural that these differences should occur in such a large family, but Sir William Larke would be glad to know that they had been kept within the family. There had been much discussion as to whether or not the chemist was of any real value, or was just another overhead to be carried on the already overburdened back of the worker, but it had now come to be believed generally that the scientific worker was of value to industry, that chemistry was not intended to replace, but to increase the value of, practical experience gained in the foundry, and that in order to meet the severe competition of to-day it was necessary to establish scientific principles and to work from those principles instead of using the casting itself for experimental purposes.

Language Difficulties.

Exception had been taken also to the language of the scientist—he referred, of course, to the published phrases, and not those used by individuals when asked if they could really melt iron in the cupola on the theoretical ratio. (Laughter.) It must be admitted, however, that all truly scientific words had some real connection with their meaning, and that once those meanings had become understood, they were of equal significance to all who heard them, not only in our own language, but in others also. Unfortunately, this was not true of all language, and generally it could be said that no two persons ever attached exactly the same shades of meaning to the same arrangement of words. Define and distinguish as we might, the combinations and permutations of language were as varied as the mixtures obtained with the usual elements found in cast iron.

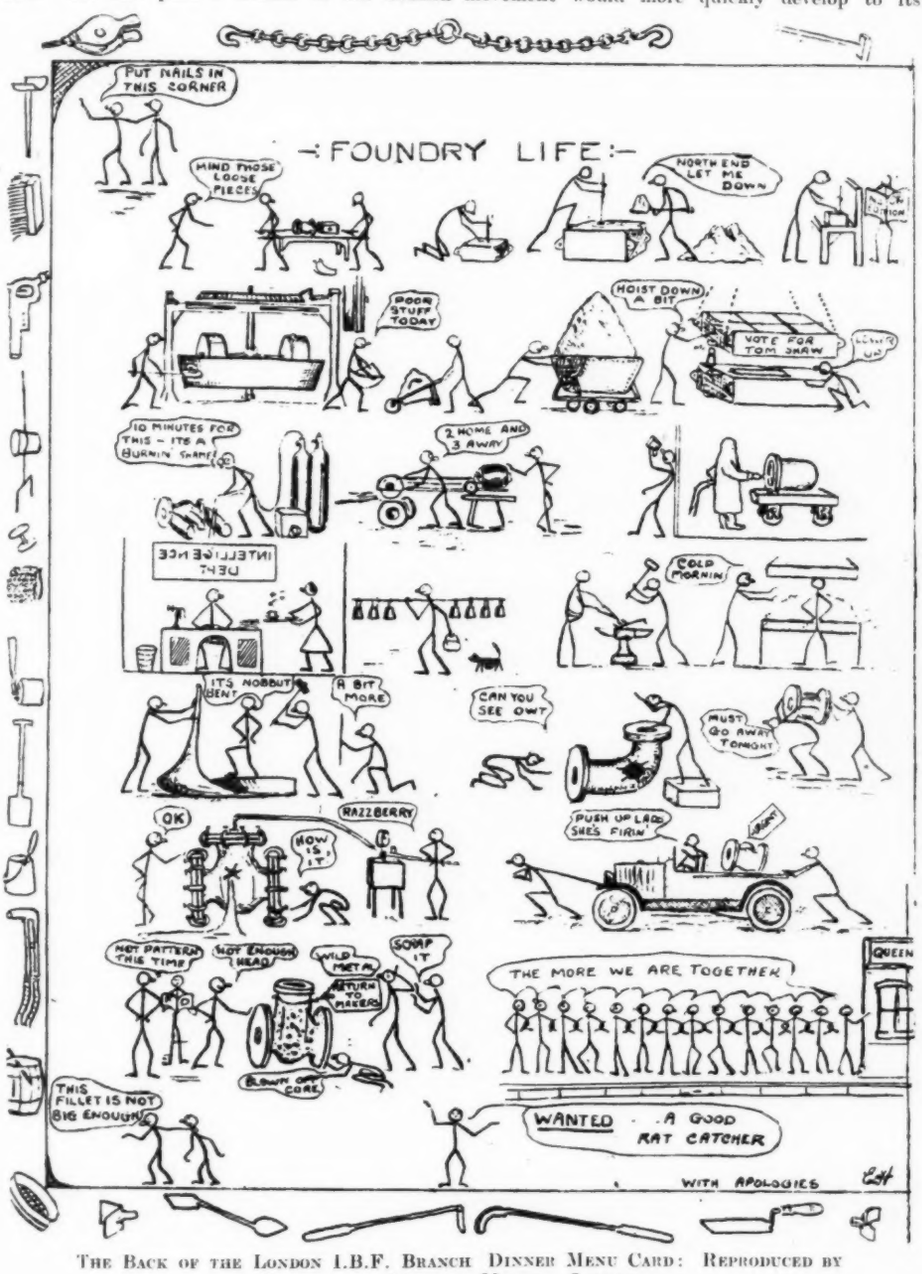
Retrogression and "Splinters."

Discussing unemployment, he said it had been stated that in order to reduce it we must send more and more of our manufactured articles abroad. This could only be done by producing articles which could be sold in foreign countries as cheaply as similar products could be made in those countries. No trade associations or price control rings could help us in this. There was only one specific, and that was efficiency. The Press was giving much space to ideals of efficient production, under many fancy names, but the Institute had been hammering away on this subject for years past, as was shown by its "Proceedings," and the important point was that it had taken root. We might not be conscious of the change, for not only were we thinking and talking efficiency, but in many cases were acting it, and thus we had reached the turning point. The foundry industry was becoming a profitable one. It had been said that when a works received visitors it was unusual to show them the foundry because it was a dirty, out-of-the-way place. Was that not the fault of the foundrymen? It could be cleaned up; one might pick up some splinters when cleaning up, but one might do well to remember that splinters were obtained only when sliding down the ladder. (Laughter.)

Job Number for Managerial Indecision.

Far too long had foundrymen listened to wailings and far too long had they been likened to Cinderellas. He was convinced that if they continued along their present lines of improvement in men, machines and methods the industry would very soon be in its true important position and would receive its just reward. Success or failure had been ascribed to many different things, but it seemed now to be agreed that all responsibility for success lay with the management. It was difficult to define how a manager's success was achieved, but no doubt if an account number could be given to the time wasted in coming to a decision, bookings to this number would give an indication of the manager's value. A manager, if he were to be successful, must have a brain and imagination capable of taking all grades without changing gear, and he urged that luxuries of equipment or system must not be allowed to drift into the position of necessities.

Reverting to the affairs of the London Branch, he said there were many reasons why it was a successful Branch. Thanks were due, in the first place, to its members, of whom there were 250. It was the only Branch which, among its present active members, has three Institute Presidents—Mr. Ellis, Mr. Faulkner and Mr. Lambert. He also paid a tribute to the Branch Council and its Hon. Secretary and Treasurer, and expressed his thanks to them for their great work.



THE BACK OF THE LONDON I.B.F. BRANCH DINNER MENU CARD: REPRODUCED BY COURTESY OF LEYLAND MOTORS, LIMITED.

Viewing from Fresh Angles develops Efficiency.

Commenting on Sir Harold Carpenter's reference to the early days at Manchester University, the President recalled a valuable lesson he had learned at that time. Some experiments were being carried out in connection with the breakdown of beta brasses into the alpha and gamma. His job was to anneal these for periods of three or four days, to take them out of the sulphur vapour, polish them, and put them under the microscope and look for dots. On one occasion he had approached Professor Carpenter in an agitated manner and had said that he could see them breaking up, but he had learned that Professor Carpenter had noticed it three series before that, and he (the President) had missed it. That emphasised the importance of looking for something a little different, and if only that were done in the foundry world, and particularly in the engineering world, the efficiency movement would more quickly develop to its alpha and gamma stages—at any rate, it would be developed.

An excellent musical programme contributed to the enjoyment of a most successful evening.

National Founders' Association.

At the 33rd Annual Convention of the National Founders' Association, held in New York on November 20 and 21, Colonel T. S. Hammond, of the Whiting Corporation, was re-elected President of the Association. Mr. S. Wells Utley, former President of the American Foundrymen's Association, was elected Vice-President; Mr. A. E. McClintock, Commissioner, and Mr. J. M. Taylor, Secretary.

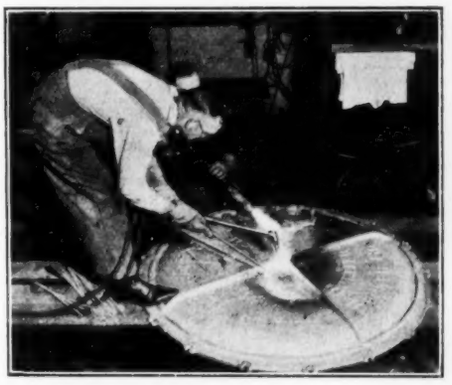
Welding an Aluminium Casting.

By C. H. S. TUPHOLME.

In welding aluminium castings it is usually recommended that the piece be carefully supported in the preheating furnace and preheated very slowly preparatory to the actual welding. Experienced aluminium welders, however, frequently dispense with the usual preheating furnace and deal with even complicated jobs entirely with local preheating, using an oil burner for the purpose.

The accompanying illustration shows a welder at work on an aluminium casting, 56 in. in diameter and ¾ in. thick, the lid of a rotary bottling machine, cracked from one edge about 20 in. toward the centre. The circular shape of the casting made the expansion problem fairly simple, although it was somewhat complicated by a manhole opening at one edge through which the crack passed, and by the fact that when the reinforcing ribs passed through the centre bearing, the metal was considerably heavier than elsewhere.

The lid had a crown of about 3 in., which increased the difficulty of penetrating the full thickness without forming projections of metal on the inside. This was to be avoided, as it would entail extensive finishing. Although preheating the entire casting in a furnace was unnecessary, it would be desirable to heat it locally along the crack, just in front of the welding flame, so the welding heat would not bring on too sudden a rise in temperature and cause further cracking.



WELDING A CRACKED ALUMINIUM LID.

In brief, the procedure was as follows: A steel plate was formed to fit the inside of the lid, and clamped to it along the crack. Then the whole casting was fastened to a flat surface and the two sides of the break were aligned at the open end by a steel strap clamped in position. After this, the opening was "veed" carefully.

First, the whole length of the break was heated slightly with an oil burner. Welding was then started at the inner end of the break, with the preheater heating the aluminium thoroughly a few inches ahead. To ensure a sound weld, both a puddling rod and cast aluminium flux were used, the object of the puddling rod being to remove oxide from the surface of the weld metal. As work progressed the preheater was still kept playing along the break, always a little ahead of the welding flame. This opened the crack up to the limit of expansion. As sections of the break were finished a covering of asbestos paper was put on, and during the work great care was taken to keep drafts of cool air from the work.

With these precautions no trouble was experienced with the welding, and the entire crack was completed in about 90 minutes. Little finishing was required.

Railway Transport Charges and the Foundry Industry.

CRITICISM OF RAILWAY CHARGES AND CLASSIFICATION.

A severe, but constructive, criticism of our present system of charging for railway transport service in this country was made by MR. P. G. DONALD at the first of a series of luncheons organised by the London Iron and Steel Exchange, at the Great Eastern Rotel, London, E.C., on Tuesday, December 10. Mr. Donald, together with Sir Geoffrey Clarke, gave evidence recently before the Royal Commission on Transport, on behalf of the London Chamber of Commerce. Mr. Donald is managing director of Messrs. Rownson, Drew & Clydesdale, Limited, and serves as a member of the Council and of the Transportation Committee of the London Chamber of Commerce.

In his discourse, Mr. Donald dealt with that part of his evidence before the Royal Commission relating particularly to iron and steel, and added information concerning the anomalies and absurdities which exist under our present system, and which result in unfairness to traders. The absurdities were such, he said, that the position in this country was ludicrous as compared with others. Transport was a factor to which, to his surprise, very few people, except perhaps those responsible for the management of large works, paid adequate attention. As an illustration of this, he recalled that he had spoken to a man who had talked glibly about having saved 6d. per ton in the buying of his pig-iron, but, after a discussion of how he consigned his goods, Mr. Donald had convinced him that for years he had been paying 10s. per ton too much on transport charges on the goods he was sending away. When one checked all the factors of costs of production, one discovered that they were really of secondary importance as compared with transport costs. High wages could be offset by modern methods; indeed, wages might go up, and yet production costs might come down. That was very much the case in the United States. Wages were considerably higher, and yet production costs, especially in the iron and steel trade, were lower.

Loading of Wagons.

Although in this country we had arrived at the 12-ton standard truck for merchandise other than that in the raw-material group, in Classes 1 to 6 in the classification, the average loading of the goods in classes above Class 6 was only 2.94 tons per 12-ton truck, according to the statistics of the Ministry of Transport. That meant that British railways were hauling trucks of 12 tons capacity with an average load of 2.94 tons, whereas, without incurring extra cost, they could be hauling truckloads of 12 tons, or thereabouts. Another peculiar fact was that, whereas the railway people in this country allocated about 34 cub. ft. for each ton in a 12-ton truck, the railway people abroad allocated 43 cub. ft. for each ton in their trucks. So that, based on Continental practice, the 12-ton truck was really only a 9½-ton truck, and based on shipping practice it was only 10 tons. That meant, presumably, that the under-carriage of each truck was capable of carrying a load of 12 tons, but they proceeded to nullify it by coming down to something less.

British and Continental Practice.

Contrasting British, Continental and American practice, the speaker said that Great Britain stood alone among the producing countries in dictating rates on a tonnage basis. In Great Britain the basis was a minimum rate for a part-truck tonnage. In Classes 1 to 6 the minimum rate was for 6 tons; in Classes 7 to 9, which included some of the manufactured goods, the minimum was for 4 tons. That 4 tons became both the minimum and the maximum tonnage that was ordered. If the railway charging system here were the same as that on the Continent, by which the rate was lowered as the load increased, we should have an entirely different commercial system. In other countries there was a maximum rate for part-truck tonnage, and a minimum rate for the full truck tonnage.

Analysing the results of these two different systems, the speaker said that in Germany, for instance, the rates for small quantities were in most cases higher than in Britain, but the rates for larger quantities were considerably lower than here; and it must not be forgotten that Germany had to pay £100 million out of their railway revenue in respect of reparations. The rates per ton for the transport of quantities up to 2 tons of iron ore over a distance of 186 miles were:—In Great Britain, 31s. 8d.; Holland, 29s. 6d.; Germany, 54s. 10d.; and in Belgium, 27s. 8d. The minimum rates were:—Great Britain, 11s. 11d.; Holland, 8s. 8d.; Germany, 9s. 2d.; and Belgium, 5s. 9d. The costs per ton of transporting 2 tons of cast-iron soil pipes were:—Great Britain, 31s. 8d.; Holland, 29s. 6d.; Germany, 54s. 10d.; and Belgium, 27s. 8d. The policy of Germany was evident there—that, if small quantities were transported, they must be paid for at a high rate, for the Germans would not have their country a retail country. For quantities of 15 tons the rates per ton were:—Great Britain, 24s. 3d.; Holland, 16s.; Germany, 19s. 6d.; and Belgium, 10s. 6d. Referring to Mr. H. J. Skelton's remarks on the dangerous possibilities of an unwise policy in regard to railway transport, in his book on "Economics of Iron and Steel," published in 1924, Mr. Donald said the disease of high transport costs could be cured if the Railway Companies recognised frankly that they were doing an injury to the country by hauling about empty trucks or trucks two-thirds empty.

Absurdities in Classification.

Dealing with some of the absurdities of the present railway classification, the speaker indicated the wide variations in the charges made, for goods of a similar nature but packed in different ways, and, on the other hand, the similarity of the prices charged for widely-varying types of goods, *e.g.*, the rate for bath salts was the same per ton as for tarred felt. With regard to coke, he said the charge for coke breeze was 14s. 7d. per ton, for granulated coke 19s. 7d., and for ground coke 20s. 2d. The rate for all three in Germany was 12s. 5d., on the basis of a full truck. Castings called "buoy sinkers" were charged for at the rate of 19s. 7d.; if they were called "Castings, iron or steel, for machines," the charge was 25s. 10d.; "Castings, iron or steel, machines M/c," 29s. 2d.; "Castings, iron or steel, heavy," 31s. 8d.; "Balusters, cast iron," 43s. In Germany and Belgium the charges for all those descriptions were the same, *i.e.*, 23s. 8d. in Germany and 10s. 6d. in Belgium.

Traders' Difficulties of Classification.

As a further instance of the difficulties which beset traders, the speaker said one might be tendering for a contract to make a quantity of a certain type of casting for export. In preparing the tender one must have regard to the railway rates which would be charged, and therefore must decide which description to give it in order to arrive at those rates. Having decided what it should be called, there was no surety that the railway company would not say, after he had closed his tender, that the goods had been misdescribed and that there would be a further charge of £250. In the railway classification there was a class of goods referred to as "Cantilevers, iron or steel," in Class 7, and there was another referred to as "Brackets, iron or steel," in Class 15, the rate on the latter class being about two and a-half times as much as that on the former. He had entered into a contract for a large quantity of cantilever brackets, and they were forwarded as "Cantilevers, iron or steel." Only that morning, however, he had received a letter from the railway authorities at the station at which the goods were received, stating that he had misdescribed the goods; it was said they were not cantilevers, but brackets. He had found that in the dictionary a cantilever was described as "a bracket, made of various materials, including iron, for the support of balconies, etc." Who was to be the arbiter, and how was business possible on that basis?

New Railway Classification.

Discussing the new railway classification, the speaker, continuing, said it had been decided, at the time of the amalgamation of the railway companies, that it should be prepared, but he could not trace that any organisation with which he was concerned had been invited to any meetings to discuss the technical aspects of it. The old classification was divided into eight classes.

Discussing the basis on which decisions as to the classification of merchandise were to be arrived at, Mr. Donald said it was stated in the Act that the Committee, in determining the class in which any particular merchandise should be placed, should, in addition to all other relevant circumstances, have regard to value (they had had no regard to anything of the kind), to the bulk in comparison to weight, to the risk of damage, to the cost of handling (none of these things seemed to have any bearing), and to the saving of cost which might result when merchandise was forwarded in large quantities.

Cure for Present Ills.

The only possible cure for our present ills was a partnership between commerce and the railways, with a sliding scale based on loading. That should bring economy of working. Evidence had been given to the Royal Commission to the effect that since pre-war days the Railway Companies had engaged 128,000 more employees, and that 58 million tons less freight was dealt with.

The principle of giving lower rates for heavier loading was already accepted, for there was a sliding scale for different tonnages in respect of iron and steel plates coated with tin, lead or aluminium. If that principle were right for one trade, why not for others? Why should not corrugated-iron sheets be dealt with on the same basis?

With regard to exceptional rates, there were six millions in existence in this country; they were granted by the Railway Companies on what he called a secretive basis, and the present policy in this connection was liable to lead to companies going bankrupt without knowing why. The present system of granting exceptional rates was unfair, involving as it did a wide variation in the charges made for similar services.

Finally, the speaker asked if the iron and steel trade was prepared to live on, under these conditions, or proposed to do something to remedy the position. If the trade took a stand in this matter it would be able to effect a reduction in costs; the railway managers would be willing to meet the trade if it made a stand, but it must make a strong stand, and must be prepared to go to the Railway Rates Tribunal if necessary, in order to secure the adoption in this country of the principle already adopted abroad.

AN AMALGAMATION of two Cornish tin-mining companies, the East Pool and Agar, Limited, and the Tolgus Mines (1927), Limited, is proposed. An offer has been made by the directors of the East Pool and Agar, Limited, to acquire the assets of the Tolgus Mines.

Hidden Facts in Oil-Sand Practice.*

By F. Hudson.

The object of this Paper is primarily to promote interest in research relative to the fundamental principles required for successful, economical and efficient oil-sand core practice. Closely allied with the sand problems, this branch of foundry work has certainly not received in this country the attention it merits by either the technical or practical man. In fact, the only outstanding literature that the author has seen is of American origin, and, in particular, a Paper, by H. W. Lane, entitled "The Core Room, its Equipment and Management." This work was presented at the 1911 annual meeting of the American Society of Mechanical Engineers, 18 years ago, yet it is extremely doubtful if the knowledge assimilated in those 18 years would add anything of import to the Paper. The Paper is a large one, of some 80 odd pages, and is well worth studying by all interested in this subject. Whilst not depreciating the work done by investigators in this country, one wonders why so valuable a field for improvement lies relatively unexplored. Perhaps it is due to the modern demand of highest possible output per man which leaves practical men little time for experiment, except in cases of need arising through routine defects. On the other hand, the technical staff have their hands full with routine control and research into the multitude of problems which spell efficiency. Naturally because moulding and core sands give such a fertile field for study, the ground work to be done is of large magnitude and requires the full-time work of investigators. The need to-day for someone to act as a clearing house for ideas and to promote research in this direction is obvious, and it is interesting to note that the Fordath Engineering Company, Limited, with whom the author has the honour to be associated, has recently installed a new and well-equipped laboratory expressly for this purpose. As one of the largest manufacturers of core oils in this country, a full-time investigation can be carried through more advantageously than in general works practice. At this time it should also be noted that this service is open to the foundry trade as a whole. Every effort has been made to procure the most modern and most accurate equipment, and in many cases apparatus has been specially designed for the work on hand.

Jobbing Shops Behindhand.

The Tyne has left its name in all parts of the world and in every trade, and the present subject is no exception to that statement, and mention should be made of Henry Watson, of Walkergate, who were one of the pioneers in the practical application of oil-sand cores. However, the use of this class of core is not as general as one would expect, except in cases of specialised production work, as is typified by foundries supplying motor-cylinder castings or stove-plate work. In these shops, core-room practices appear nearly perfect, yet conditions are found which cause loss of time and money. For example, some firms spend painstaking care in best design of core boxes, drying stoves and employ the most suitable core binder, yet use quite unsuitable sands. Unsuitable sands can cause extremely heavy waste, in the amount of binder used (especially in the thin-oil group, such as linseed, etc.), as the presence of clay or other colloidal matter in the sand destroys the effective bonding power of the binder, and larger quantities of binder must be used to obtain the necessary strength. The same applies to the use of fine-grained sharp sands, bonded with thin oils, although perhaps to a less degree. The larger the sand grain, then the less binder is required to obtain a given strength. In the average jobbing foundry, the use of oil-sand cores has not been in keeping with modern progress, and invariably they are hampered with conditions considered as fixtures, such as badly-designed drying stoves, cheap local sands, or a prejudice in favour of certain binding material. All these points mitigate against efficient core-room practice and against the extended adoption of oil-sand cores, and to-day's need is unquestionably one of educating the practical man regarding those fundamental facts which are not readily observed in every-day practice. The benefits derived from efficient oil-sand practice are now fairly well known and, accordingly, little mention will be made of them in this Paper. Sufficient is it to note that oil-sand cores are more or less indispensable to motor-cylinder production and stove-plate work, whilst larger castings are being made every day, cored out entirely with artificially-bonded sand mixtures. In fact, several foundries are even adding oil compounds to large loam work and getting benefits in strength, permeability, appearance and freedom from drying cracks. This is the standard practice in one Clyde foundry making large Diesel-engine castings, and was successfully used at the Close Works foundry of Armstrong Whitworth several years ago on large low-pressure marine-cylinder cores with excellent results.

The points to receive attention in this Paper can be stated as follow:—(1) *Effect of sand relative to binder economy and core*—(*a*) strength, (*b*) permeability, (*c*) finish, (*d*) heat conductivity, (*e*) refractoriness and (*f*) gas evolution on casting; and (2) *effect of binders relative to core*—(*a*) strength, (*b*) permeability, (*c*) finish and (*d*) gas evolution on casting.

A general description of the laboratory equipment and methods used will give a more ready understanding of the Paper. Fig. 1 shows the analytical laboratory where the chemical side of core oils receives attention, and in Fig. 2 the practical sand-testing room. In studying the oil-sand core question the first thing desired is a definite knowledge of the grain size of the various core sands used. This information is obtained by the sieve and subsidence test.

Sieve and Subsidence Test.

Sieve testing is no doubt familiar to most foundrymen as well as the controversial discussions which invariably arise regarding the kind of sieves used. Sand-testing sieves can be obtained in wire mesh or punched copper. This latter type, unfortunately, is only obtainable in the larger mesh sizes and reliance on the wire-cloth type becomes essential for separation of the finer grades. Ordinary wire-cloth sieves are unreliable, due to the possibility of variation in size of mesh opening, but this can be overcome by using "crimped" wire cloth. The sieves used by the author for sand testing are of this latter type and to I.M.M.E. standard. Fig. 3 shows the difference between ordinary and "crimped" wire cloth as used for making sieves. The actual sieving operation is conducted on a Sturtevant mechanical sieve tester as shown in Fig. 4. This machine imparts intensive vibration to the nest of sieves and is controlled by a time switch for any standard time duration. All sieve tests are checked by Fletcher's subsidence test, a full description of the method used appearing in the Proceedings of the Institute of British Foundrymen.

Green-bond strength, and the physical tests on the baked core, such as tensile, transverse and permeability, are conducted as outlined in the author's Paper on "Scottish Moulding Sands,"* with the exception that machines have now been designed for the tensile and transverse tests instead of the old method of loading by hanging weights. Fig. 5 illustrates the tensile machine which is used extensively for cement testing, and in Fig. 6 is the transverse testing machine to the author's design. An excellent index of the air-hardening propensities of core compositions can be obtained by making two green dropping test-piece cores and breaking one immediately and allowing the other to stand for half an hour. The subtraction of the two results gives one an index of the air-drying propensities.

FIG. 1.—ANALYTICAL LABORATORY.

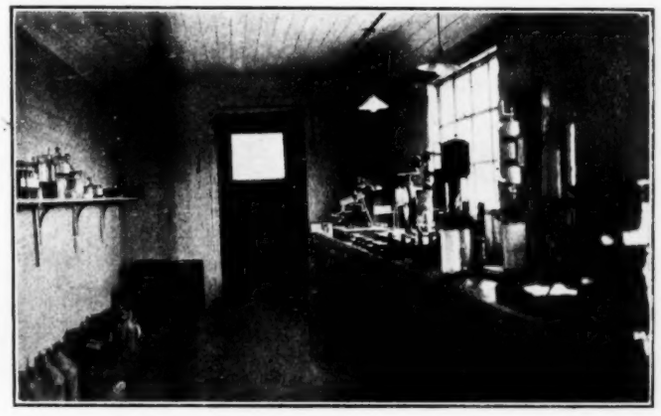


FIG. 2.—PRACTICAL SAND-TESTING DEPARTMENT.

* A Paper presented to the Newcastle Branch of the Institute of British Foundrymen. Mr. Smith presiding.

* FOUNDRY TRADE JOURNAL, April 12 and 19, 1928.

Gas Evolution after Baking.

Fig. 7 shows the apparatus used for the determination of gas content. It consists of a small tube furnace (*a*), connected up to a graduated aspirating system (*b*, *c*), having a monometer gauge (*d*) for atmospheric pressure correction. The *modus operandi* is as follows: A baked core (*e*), ¾ in. dia. x 3 in. long, is weighed fairly accurately to the first decimal place. (This usually runs around 40 to 45 grms.) The core is now introduced into the furnace, which is at

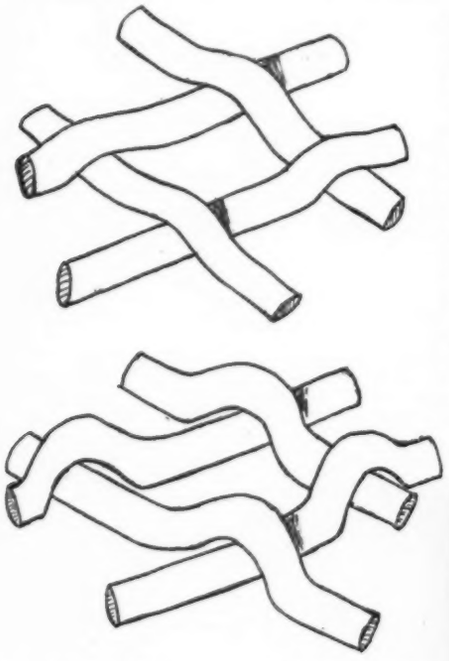


Fig. 3.—Top, Ordinary Wire-Cloth. Bottom, "Crimped" Wire Cloth.

800 to 900 deg. C., and the furnace is sealed by the rubber bung (*f*). The aspirating system is now turned on by the cock (*g*), and as the fumes and gas are formed they are automatically extracted from the furnace. After half an hour all gas has been given off and the pressure adjusted to atmospheric and the quantity collected

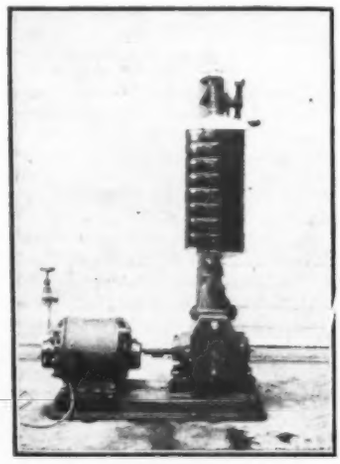


Fig. 4.—Sturtevant Mechanical Sieve Tester.

read off on the aspirator scale in cubic centimetres. The weight of core taken divided into the amount of gas formed gives the quantity of gas generated per unit of weight. It is interesting to note that any condensation of tarry matter or after-solution with the gas in water does not affect the accuracy of the test, as the water-level in the aspirator falls immediately the gas is generated in the furnace. Fig. 8 illustrates this equipment.

The foregoing constitutes a brief description of the apparatus used in practical experimental work on oil-sand core mixtures. The degree of ramming is not important with sands free from clay, and no provision is necessary for uniformity in this connection, providing average intelligence is used. In concluding this section, the most important adjunct to successful results merits more detailed remarks, and this adjunct is unquestionably the baking oven or stove. The importance of this question can be best illustrated by a practical example which befell the author only a few weeks ago at the works of Messrs. Glenfield & Kennedy. A stove had been converted for oil-sand practice, and instead of using the standard chimney for removing exhaust fumes and obtaining the necessary supply of oxygen for drying the cores, a suction fan was used on the exhaust flues. With this powerful circulation, cores were dried extremely fast at 400 deg. Fah., and, in fact, if careful control of the dampers were not enforced, the outside of the cores were burnt whilst the centre was still green. On the other hand, in the author's laboratory there is an electric oven with weak circulation, and very much higher drying temperatures can be employed without burning the core, using the same kind of oil bond. It is doubtful whether two foundries have similar drying conditions, and some correlation of the degree of air or oxygen circulation, together

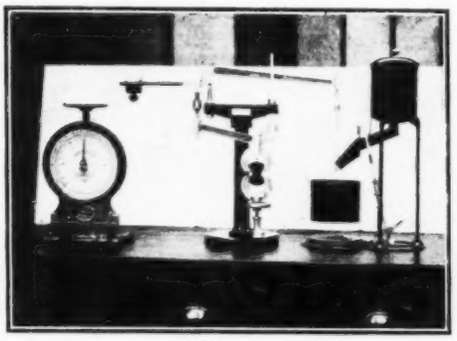


Fig. 5.—Tensile Testing Machine for Baked Cores.

with temperature employed, against drying time and physical properties possessed by the finished baked core, are essential. Obviously these conditions must be standardised if laboratory results are to be of practical benefit, and it will also enable one foundry to get equally good results as another. What is required is to have a comparison of the amount of oxygen or air required at a certain stove temperature to dry out cores of a definite section in the shortest time consistent with the most suitable physical properties developed in the core. For this work, the oven used in the author's laboratory has been fitted up as shown in Fig. 9. The oven is heated by electricity and air at various velocities is supplied by the small electric blower at (*a*), being preheated to the oven temperature by passing through the copper coil (*b*). In the exhaust flue at (*c*) is a pitot tube showing the amount of air passing per second. Two thermometers serve for temperature measurement. Unfortunately this is such a recent development that as yet conclusive results have not been obtained. However, no doubt this matter is of interest, and it will serve to show how the question is being tackled.

Effect of Sand Relative to Binder Economy and Core Strength.

The correct grade of sand is just as essential for oil-sand work as it is for moulding purposes, and to obtain the best cores consistent with binder economy it is important to use sand free from clay for thin binders, and containing a small percentage of clay for thick binders, and of a correct grain-size. The size of the sand grain being determined principally by the metal used for casting, and the type of binder used. The presence of clay or fine particles invariably causes thin oil binders to segregate and larger quantities of binder must be used to get the necessary strength. The same analogy applies to fine-grained sands although to a less extent, as due to the larger surface area of the total grains more binder is required to form the grain coating. To illustrate this point in a simple manner a sample of Irvine sea sand was obtained and graded into two portions, termed coarse and fine. The *coarse* sand was that passing a 20-mesh sieve but remaining on 80-mesh, whilst the *fine* sand was that passing 80-mesh. To each of these samples 3 per cent. of water and 2 per cent. of boiled linseed oil was added and the mixtures made into test cores. The results obtained are shown in Table I. Included in this table there is also a comparison between fairly coarse sand such as Irvine sea sand and a naturally fine sand from Kirkintilloch called Balquharrage sand.

Table I.—*Effect of Clay on Binder Economy.*
(Dried at 450 deg. F.)

Sand mixture.	Green dropping test. (In.)	Tensile. (Lbs. per sq. in.)	Transverse. (Lbs. per sq. in.)	Perm. (Secs.)
*Irvine (coarse) ..	1.1	87.4	24.5	46.0
„ (fine) ..	1.4	34.75	12.5	—
Natural sands—				
Irvine sea sand	1.2	80.5	35.7	41.0
Balquharrage	1.42	71.7	21.25	55.5
Southport sea sand	—	341.0	60.75	52.5
Ryarsh silica ..	—	266.0	38.25	97.5

* Irvine sea sand was graded into two portions, as follows:—*Coarse*—passing 20 remaining on 80 mesh, and *fine*—passing 80 mesh. All above sands mixed with 2 per cent. linseed oil.

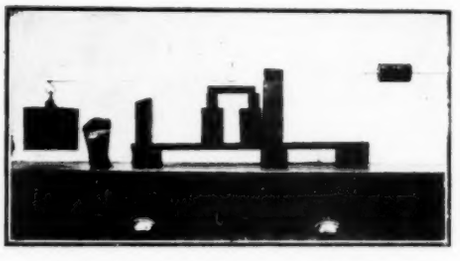


Fig. 6.—Transverse Testing Machine for Cores, designed by the Author.

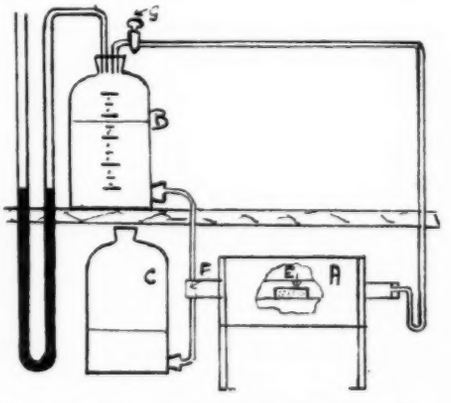


Fig. 7.—Apparatus for determining the Gas Content of Cores.

The results show similar figures to the preceding example. It must be understood, however, that these results only apply to core sands

using thin oils as binders, in the most *economical* proportions. After 4 per cent. oil addition, the test results are entirely reversed and the finer sands invariably produce the stronger cores due to the greater number of contact points between the sand grains. When using thick oils, creams and semi-solid compositions, the matter is not of very great moment as regards economy, in fact

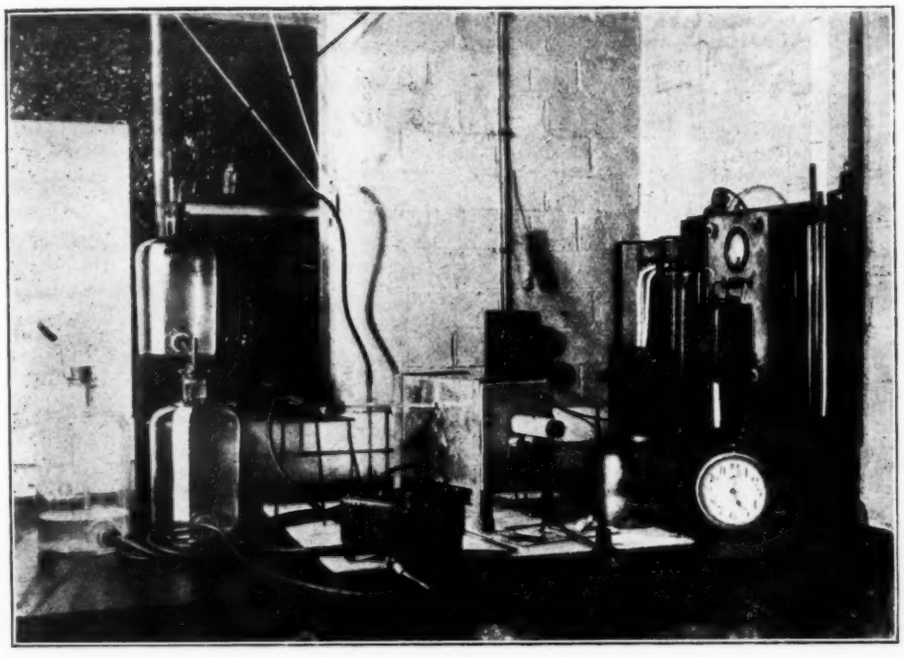


FIG. 8.—ILLUSTRATING THE APPARATUS SHOWN IN FIG. 7.

it is good practice to use a fine sand, as greater bond is obtained in the green condition. This is also obvious from Table I.

Another factor of some importance relative to the final core strength obtained is the presence of excessive, soluble alkali salts in the core sands. Alkali weakens most core binders and is far more detrimental to them than the common alkaline materials such as lime, etc., are on the refractoriness of the sand. That this matter is of no little importance is apparent when one considers

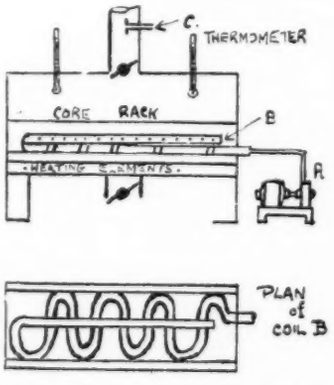


FIG. 9.—THE ELECTRICALLY-HEATED CORE OVEN INSTALLED IN THE AUTHOR'S LABORATORY.

how many foundries use polluted river and canal waters and obtain sand supplies from contaminated deposits. The author has seen oil-sand cores produced in America from reclaimed old sand possessing superior properties, as regards strength and economy, than cores made from the first-class sand deposits of this country.

The reason for this unquestionably lay in the fact that the American foundry in question had installed special equipment for washing and removing the fines from the old sand. Furthermore, the sand grains had already been coated with oil, and probably this facilitated the production of stronger cores after remixing. The last point in regard to sand as effecting core strength and binder economy is one of moisture content. Damp sand is more bulky and lighter than the dried material and varies with each consignment. The correct amount of oil cannot be added unless the amount of water in the sand is determined or the sand is dried. The use of sand having variable moisture content results in excessive core-binder costs, although water usually produces stronger cores after baking.

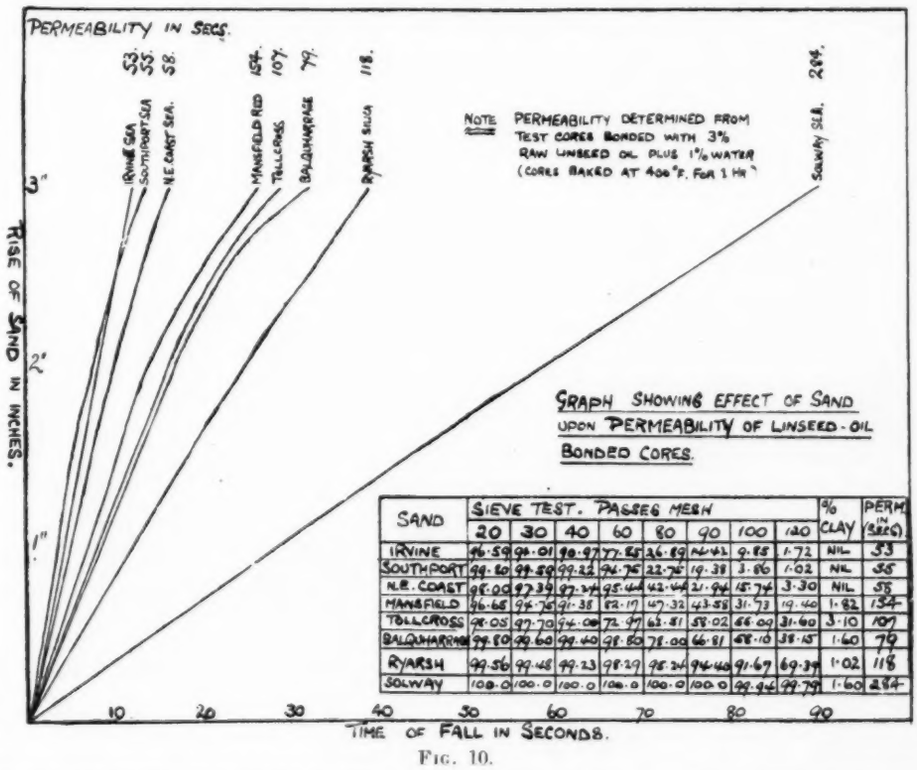
For successful oil-sand practice the sand should be dried, or allowed to temper down to a reasonably low consistent moisture content by covered bulk storage. The points required of sand for best core strength consistent with maximum binder economy can be summed up as follow: (1) (When used with linseed and other thin oil compositions) employ a clean rounded grained sand as coarse as possible consistent with the casting finish, containing no clay, fine grades, soluble alkali salts. The moisture content should be nil or at a reasonably consistent figure not exceeding a total of 4 per cent. including the oil addition. For cast iron, the ideal sand should be of a grade which 100 per cent. will pass 40 or 60 mesh whilst not passing through an 80-mesh sieve. Such a sand will give the necessary strength with oil additions not exceeding 2 per cent. maximum. (As an example of economy with efficiency, the Ford Works at Detroit use an oil-sand mixture containing between 0.8 to 0.9 per cent. oil—see Table II), and (2) (when using thick oils or semi-solid compositions) it is best to employ a sand as fine as possible, consistent with suitable permeability, for the type of castings being made, containing approximately 1 to 2 per cent. of colloidal bond. The sand should be free from soluble alkali salts and contain not more than 1 per cent. of moisture if green bond is desired.

Paragraph No. 1, it will be observed, is quite

TABLE II.—*Strength of Cores using Low Linseed Oil Percentages.* (*Southport Sand used.*)
(All Test Cores baked at 400 deg. F. for One Hour.)

Mixture.	Tensile. (Lbs. per sq. in.)	Transverse. (Lbs. per sq. in.)	Gas evolved. (C.c. per grm.)	Perm. (Secs.)
3 per cent. oil ..	336.5	73.69	22.8	53.5
2 ,, ,, ..	329.0	68.07	18.7	51.0
1 ,, ,, ..	146.0	20.38	16.35	45.0
0.8 per cent. oil..	147.0	21.38	14.37	50.0
0.8 ,, ,, *	118.0	21.12	10.9	47.0

* Southport sea sand graded to pass 60 mesh, retained on 80 mesh and washed. In each case water added plus oil was 5 per cent.


PERMEABILITY IN SECS.
53. 55. 58. 154. 107. 79. 118. 284.
IRVINE SEA
SOUTHPORT SEA
N.E. COAST SEA.
MANSFIELD RED
TOLLCROSS
BALQUHARRAGE
RYARSH SILICA
SOLWAY SEA.
NOTE PERMEABILITY DETERMINED FROM TEST CORES BONDED WITH 3% RAW LINSEED OIL PLUS 1% WATER (CORES BAKED AT 400°F. FOR 1 HR.)
3"
2"
1"
RISE OF SAND IN INCHES.
10 20 30 40 50 60 70 80 90
TIME OF FALL IN SECONDS.
GRAPH SHOWING EFFECT OF SAND UPON PERMEABILITY OF LINSEED-OIL BONDED CORES.

SAND	SIEVE TEST. PASSES MESH								% CLAY	PERM. (SECS.)
	20	30	40	60	80	90	100	120		
IRVINE	96.59	90.01	90.97	77.85	36.89	24.42	9.85	1.72	NIL	53
SOUTHPORT	99.60	99.89	99.22	94.76	22.76	19.38	3.86	1.02	NIL	55
N.E. COAST	98.00	97.39	97.24	95.64	42.64	21.94	15.74	3.30	NIL	58
MANSFIELD	96.65	94.76	91.38	82.17	47.32	43.58	31.73	19.40	1.82	154
TOLLCROSS	98.05	97.70	94.08	72.97	62.81	58.02	46.09	31.60	3.10	107
BALQUHARRAGE	99.80	99.60	99.40	98.60	78.00	66.81	48.10	38.15	1.60	79
RYARSH	99.56	99.48	99.23	98.29	95.24	94.46	91.67	69.39	1.02	118
SOLWAY	100.0	100.0	100.0	100.0	100.0	100.0	99.96	99.79	1.60	284

FIG. 10.

definite in statement, but in paragraph No. 2 this class of core mixtures must necessarily vary to a degree according to the type of core. In one case, green-bond strength is not required, whilst in the other it is of great importance.

Effect of Sand Relative to Binder Economy and Core Permeability.

The permeability of oil-sand cores is principally determined by the nature of the sand itself and the amount of binder present. As the strongest cores bonded with thin oils are composed from fairly large-grained sands, so naturally the permeability is exceptionally good. Fig. 10 gives an indication of sand fineness values by sieve and subsidence test in comparison with resulting core permeabilities made up with 3 per cent. raw linseed oil, and it is interesting to note that the presence of colloidal bonding matter is more detrimental to permeability than grain size. This is particularly apparent in a comparison between, say, Tollcross and Balquharrage sands. If anything, Balquharrage sand is finer than Tollcross, yet due to the presence of 3.1 per cent. clay in this latter sand the permeability figure is 107 against 79 for Balquharrage. Again, Mansfield sand is coarser in grain than Tollcross, yet due to its colloidal-bond content the permeability is as high as 154. For thin-oil mixtures it undoubtedly pays to keep out clay, and accordingly the author sees no object whatsoever in blending sands or using sand mixtures for oil-sand core practice when thin oil binders are used. It is more efficient to use creams or semi-solid binders and certainly more economical. The addition of 25 per cent. of red sand such as Mansfield or Belfast when used with semi-solid core compounds does not increase the permeability in the slightest. It is interesting to note that less quantities of thick binding mediums can be used with blended sands, whilst the opposite is the case when using thin-oil binders. Table III shows a comparison between the core permeabilities of ordinary and blended mixtures.

Table III.—*Showing the effect of Red Sand addition against Ordinary Mixtures.*
(All Cores baked at 400 deg. F. for One Hour.)

Mixture.	Tensile. (Lbs. per sq. in.)	Transverse. (Lbs. per sq. in.)	Gas content. (C.c. per grm.)	Perm. (Secs.)	Green bond strength. (Inches.)
76 parts Southport sea sand, 24 parts Mansfield red sand, 3 per cent. raw linseed oil, 1 per cent. water	185.0	29.25	17.85	78.0	1.23
100 parts Southport sea sand, 3 per cent. raw linseed oil, 1 per cent. water.. ..	336.5	73.69	22.8	53.5	0.9
76 parts Southport sea sand, 24 parts Mansfield red sand, 3 per cent. Glyso S.S.	124.0	20.25	16.58	62.0	3.18
As above, but adding 2 per cent. water ..	164.0	24.8	16.18	52.0	2.06
As above, but with 3 per cent. water ..	208.0	32.07	18.63	52.0	1.98
100 parts Southport sea sand, 4 per cent. Glyso S.S., ½ per cent. water	448.0	80.125	21.34	50.0	2.18

Effect of Sand Relative to Core Finish.

To obtain smooth-surfaced castings it is advisable to use a blended-sand core mixture. Cores made from such a mixture need not be black-washed. However, it is important that the remarks made in the foregoing paragraphs should be carefully considered to obtain efficient and economical working, and the binder should not be of the thin-oil type. For general ironfoundry work, the addition of 20 to 25 per cent. of red sand to sea sand gives very satisfactory results, although the percentage of red sand should be increased for general brass foundry practice. In fact, for small castings such as gear wheels, etc., an oil-sand mixture made entirely from red sand has been used with success.

Effect of Sand Relative to "Workability."

By workability, is meant the manner in which green cores leave the core box and other points of manipulation common to general core-room practice. Sand, however, does not play a large part in considering this matter, and it will be dealt with later under the heading of "Binder Effects."

Effect of Sand Relative to Core-Heat Conductivity and Refractoriness.

These points are of much greater importance than general mention implies. Foundrymen are to-day quite familiar with core strengths and permeability, yet little is said regarding core-heat conductivity. The heat conductivity of a core is a distinctly important feature and

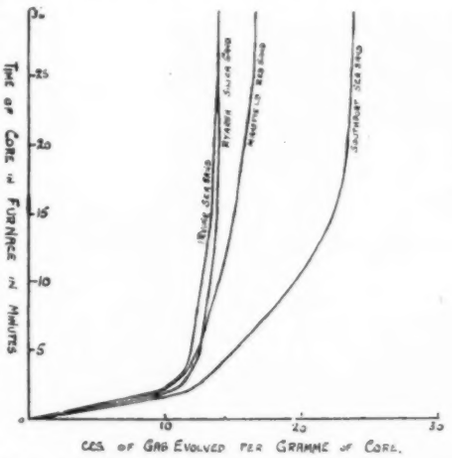


Fig. 11.—Effect of Sand Heat Conductivity upon the Gas Content.

can help the foundryman in many useful ways. For example, a knowledge of this point leads to better core venting. Heat conductivity depends mainly upon the refractory material of which the core is composed. This should be of such a nature that it conducts heat but slowly, so that the rate at which the succeeding layers of hydrocarbon, or baked binder, are gasified is sufficiently slow to enable the vent to take care of the gases as they are formed. Whilst the permeability of a core may be satisfactory, the core sand could conduct the heat from the metal too rapidly, and this would lead to a large amount of gas being formed, which would not get away through the vents quick enough and so cause defective castings. The whole question of permeability in the first case depends essentially upon the amount of gas generated in the mould and the removal of that gas. Fig. 11 illustrates an interesting example of the effect of sand heat conductivity upon gas generation. At the present time, work is being done in this matter in the author's laboratory, and it is hoped that at some future date the research will reach conclusion and publication. On the other hand, by the use of high heat-conductivity refractory sands, it is very feasible that cores could be employed to act as chills and denseners without most of the trouble at present consequent to their use. It is also apparent that the heat-conductivity of sand used for oil-sand cores determines to some extent the ease of fettling, especially on production work stripped soon after casting.

In regard to the refractoriness of sand little need be said; as most core sands come under the high-silica class and are consequently of a high refractory order. Rough-surfaced or "siezed" castings are generally due to the use of too open a core rather than to defective refractoriness. Open cores necessitate the use of black-wash to close the surface pores for the production of smooth-skinned work. On the other hand, equal casting finish could be obtained without the use of black-wash by the use of a closer-grained sand or by a blended mixture. Core box finish and the use of sticky sand mixtures must also be taken into account.

Effect of Sand Relative to Gas Evolution on Casting.

This point has been seriously overlooked in the past, and particular note should be made of Table IV. This shows the volume of gas generated from ordinary core sands without any oil or other binder addition whatsoever, but baked in the core oven for the time and temperature usually employed for drying cores. The figures shown are nearly unbelievable, and they show that in many core sands the amount of gas evolved on casting is more than that given off by the burning binder. Taking Southport sea sand as a typical example, it will be noticed that it evolves 13.27 c.cs. of gas per grm. of core when tested without any binder addition, whilst a core of the same sand bonded with 3 per cent. linseed oil evolves 23.94 c.cs. of gas per grm. of core. In other words, the core sand evolves only 13.27 c.cs. of gas whilst the binder evolves only 10.67 c.cs. of gas per unit of core weight. The sands on the North-East Coast evolve the largest amount of gas in the samples tested for this Paper and, unfortunately, the quantity available precluded a gas content to be determined on a core made up with a binder addition. Table V gives the relative comparison of gas evolved from four core sands, with and without the binder. Complaints are often made by founders that the core oil gives off *too* much gas or fumes, and in view of the above figures it is advisable to remember that in many cases this statement is totally unfair to the quality of the oil.

Table IV.—*Gas evolved from Core Sands, without Oil addition, after Baking at 400 deg. F. for One Hour.*

Sand.	Gas evolved. (C.c. per grm.)
Glasgow District.	
Irvine sea sand	2.28
Tollcross sand	12.70
Tyneside.	
N.E. Coast sea sand	17.40
Birmingham District.	
Mansfield red sand	3.20
Ryarsh silica sand	4.68
Southport sea sand	13.27
America (U.S.A.).	
Williamstown silica	1.33

Table V.—*Gas evolved from Core Sands, with and without the addition of 3 per cent. Raw Linseed Oil.*

Sand.	Gas evolved from sand. (C.c. per grm.)	From sand plus binder.	From binder alone.
Irvine sea sand ..	2.28	14.10	11.82
Ryarsh silica ..	4.68	13.85	9.17
Mansfield red ..	3.20	16.90	13.70
Southport sea sand	13.27	23.94	10.67

(*To be continued.*)

The annual Smithfield Show dinner of Messrs. R. A. Lister & Company, Limited, of Dursley, was held on December 10 at the Hotel Victoria, London. The principal guests were Mr. J. R. Clynes, the Home Secretary, and Sir Horace J. Wilson, the Permanent Secretary to the Ministry of Labour. Mr. Percy Lister, who presided, said that during the past twelve months his firm had established another record year's trading, and had nearly doubled the extent of their works.

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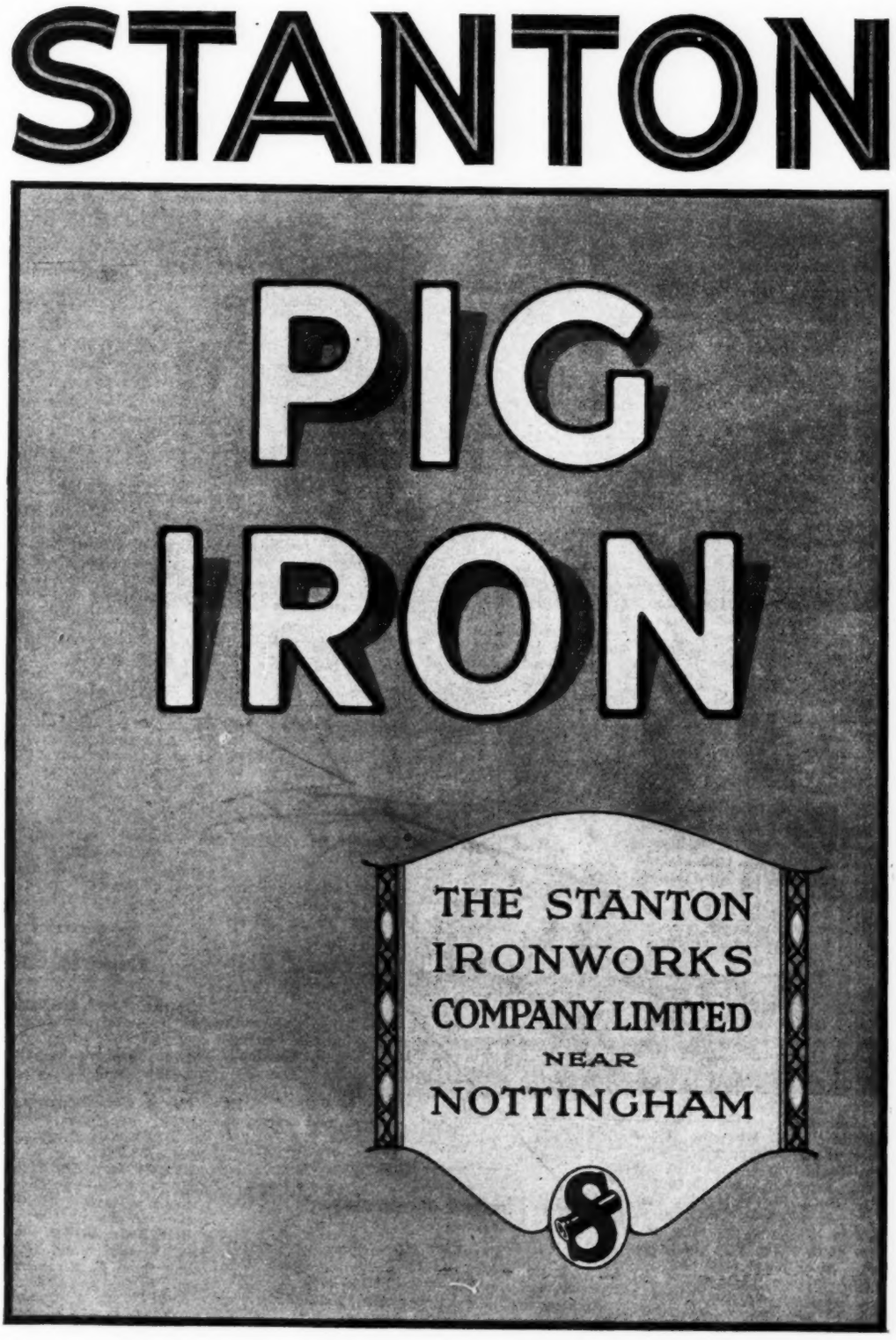
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Trade Talk.

The offices of the newly-formed company, Ruston-Bucyrus, Limited, manufacturers of excavating machinery, are at Lincoln.

The London Midland & Scottish Railway Company announce that they have placed an order for 30 locomotives, at a cost of £300,000, with Messrs. Beyer, Peacock & Company, Limited, Manchester.

A message cabled from Johannesburg states that the South African Railways have placed an order with the Metropolitan-Cammell Carriage, Wagon & Finance Company, Limited, for 1,000 steel wagons.

The North British Locomotive Company, Limited, Springburn, Glasgow, have secured an order from the Rhodesia Railways for twelve 4-8-2 locomotives of the twelfth class, weighing about 130 tons each.

In order to provide direct communication between North Wales and Lancashire and Cheshire, the construction of a bridge and embankment across the mouth of the River Dee between Point of Ayr and West Kirby is proposed.

Messrs. Yarrow & Company, Limited, Scotstoun, have received an order from the British Admiralty for a shallow-draft gunboat. This will be the fifth vessel of the type to be designed and constructed by the firm.

In addition to the orders for seven vessels recently obtained, the Furness Shipbuilding Company, Limited, Haverton Hill-on-Tees, have secured a contract for another oil tanker of 3,400 tons for use on the Canadian lakes.

Messrs. Riley Bros. (Boilermakers), Limited, Stockton-on-Tees, who a few weeks ago booked an order for 12 large marine boilers for the Gotaverken Shipyard, Sweden, have received from the same firm an order for four additional boilers.

It is announced in the London "Daily Telegraph" that, following the request of many Belgian manufacturers, the International Exhibition in Brussels, fixed for 1930, has been postponed until 1931.

A return of vessels launched by Messrs. Vickers-Armstrongs, Limited, at their Naval Construction Works, Barrow, in 1929 shows an approximate gross tonnage of 29,440 and machinery of 77,350 h.p. Last year's tonnage was 31,350 and the engine horse-power 31,700.

Employees of the following firms have made various contributions to Scottish charitable institutions and infirmaries:—Messrs. Barr & Stroud, Limited, Anniesland, Glasgow, £128; the Pather Iron & Steel Company, Limited, Wishaw, £135 5s. for the year ended December, 1929; and the Albion Motor Car Company, Limited, Scotstoun, Glasgow, £700 during 1929.

Orders for 45,000 tons of rails were placed on December 5 with the Belgian and Luxemburg works by the Narrow Gauge and Congo Railway. Contracts for 40,000 tons of rails for 1930 are reported to have been entered into by the Czecho-Slovak State Railways with the Prague Eisenindustrie Company, the Berg- and Hüttenwerks Gesellschaft and the Witkowitz Ironworks.

Mr. G. M. Gillett, M.P., Parliamentary Secretary to the Department of Overseas Trade, informed the Birmingham Chamber of Commerce that he was appointing a committee to examine the present situation regarding the British Industries Fair and to consider what means could be adopted to increase still further its utility to British trade. Lord Chelmsford would be chairman of the committee.

At the Ramsay Chemical Dinner, held in Glasgow on December 12, an appeal was made for the improvement of the equipment in the Chemical Department of the University of Glasgow. Principal Rait declared that the buildings, which were of a temporary nature, had grown venerable in the temporary period of their existence. The chairman, Professor Frederick G. Donnan, of University College, London, put it that it would be a disgrace to Scotland if an up-to-date laboratory was not provided at the University of Glasgow, with the traditions it bore as a centre of chemical research.

The trials of the new steamers "Limpopo" and "Islander," built by the Grangemouth Dockyard Company, Limited, have been satisfactorily completed. The speed of the former exceeded the contract speed by half a knot, and the latter by nearly a knot above the contract speed. The "Limpopo" has been built for owners in Lourenço Marques, and is intended for service on the Limpopo River and the Portuguese East-African Coast. The "Islander" has been built for the Christmas Island Phosphate Company, Limited, London, and is intended for service between Christmas Island and Singapore.

Messrs. Cox & Danks, Limited, who are engaged on the salvage of the scuttled ex-German Fleet at Scapa Flow, were successful on November 27 in raising the 4,000-ton light cruiser "Bremse." The "Bremse" has been successfully towed in her completely upside-down position to the firm's shipbreaking depôt at Lyness Pier—a distance of 10 miles—where she will be dismantled. This is the 29th ship Messrs. Cox & Danks, Limited, have raised since they commenced their operations at Scapa Flow in 1924. At the beginning of next year their attention will be directed to the 27,000-ton battle cruiser "Hindenburg" and the 20,000-ton battle cruiser "Von der Tann."

In November the total number of unemployed members of the Amalgamated Engineering Union decreased, and a Glasgow delegate reports that trade has been remarkably steady for the time of year, although the opinion is expressed that the figures are not altogether representative of the true position and are contrary to that at the time of reporting. The outlook is none too bright, but, while the future has to be discounted in certain known directions, there may be possibilities of improvement in unexpected directions. The Paisley correspondent reports that there appears to have been some improvement in the area, except at Dumfries. The reports from Edinburgh and Dundee also indicate some improvement, particularly in regard to the Jute industry in Dundee.

A move for the rationalisation of the business of Messrs. John Brown & Company, Limited, of Sheffield and Clydebank, possibly in conjunction with other firms, is foreshadowed in a circular to the shareholders stating that it is not proposed to pay any interim dividend on the preference or ordinary shares. The circular adds that the board have under consideration certain important measures for the rationalisation of the business of the company, either alone or with others. So soon as these proposals are completed, they will be submitted to the holders of securities of the company for approval. In the meantime, the board consider it necessary to conserve the cash position of the company as much as possible, although the trading results for the first six months of the current financial year favourably compare with the corresponding six months of last year. It will be remembered that at the annual meeting of Messrs. John Brown & Company, Limited, in June last, Lord Aberconway, the chairman, stated that the company had been invited to join the combine of which the English Steel Corporation, Limited, was the outcome. It is believed, however, that in any ultimate scheme of amalgamation or co-operation, Messrs. Thomas Firth & Sons, Limited, will be found to be associated.

Contracts Open.

Ely, January 6.—25,800 yds. of cast-iron water mains, for the Ely Rural District Council. Messrs. Silcock & Simpson, 25, Victoria Street, Westminster, S.W.

London, N., January 17.—Iron and steel stores, for the Islington Borough Council. Mr. R. H. Jerman, town clerk, Municipal Buildings, Upper Street, N.1.

Londonderry, February 10.—12-in. steel pipes, with cast-steel ball and socket joints, for the Londonderry Corporation. Mr. W. Criswell, Guildhall, Londonderry. (Fee £5 5s., returnable.)

Pentre, December 21.—1,100 tons of cast-iron pipes, etc., for the Rhondda Urban District Council. Mr. E. Taylor, engineer and surveyor, Council Offices, Pentre.

New Companies.

Telephone Manufacturing Company (1929), Limited, Hollingsworth Works, Martell Road, West Dulwich, London, S.E.—Capital £250,000.

Amalgamated Metal Corporation, Limited, Princes House, Gresham Street, London, E.C.—Capital £5,000,000 in £1 shares, to acquire all or part of the share or loan capital or the assets or undertaking of the British Metal Corporation, Limited, and Henry Gardner & Company, Limited, and to carry on business as buyers, sellers and manufacturers of ores, metals and minerals, etc. Directors: Sir Auckland C. Geddes, Sir Evelyn A. Wallers, C. V. Sale, O. Lyttelton, W. S. Robinson, H. Gardner, W. Gardner and A. J. H. Smith.

Personal.

Sir Gilbert C. Vyle has been re-elected President of the British Engineers' Association for the year 1929-1930.

A pleasing ceremony took place in the pattern-making department of Messrs. Smith & Wellstood, Limited, Bonnybridge, on December 9, when Mr. Mr. David McPhie was presented by his fellow-workers with a clock as a token of esteem and to mark the occasion of his marriage.

Mr. J. Allen Thornton, works manager of the Britannia Steelworks and the Newport Ironworks, Middlesbrough, of Messrs. Dorman, Long & Company, Limited, has been appointed general manager of the Partington Steel & Iron Company, Limited, Irlam, Manchester. Mr. Thornton went to Middlesbrough about 12 years ago from Messrs. Andrew Knowles & Company, Limited, Manchester. In taking up his new position Mr. Thornton will succeed Mr. J. S. Kerr (formerly of Messrs. Bolckow, Vaughan & Company, Limited), who is now managing director of the Partington Works.

Obituary.

Mr. Archibald Gemmell, a craneman in the North British Steel Foundry, Bathgate, was killed on December 14 through touching a live wire. He had been cleaning the crane whilst the current was on, and accidentally placed his arm against the wire. The deceased had been for a long time in the employ of the firm.

Mr. Thomas MacKenzie, manager of the Westburn Steelworks, Glasgow, of Messrs. Redpath, Brown & Company, Limited, died on Sunday, December 8. Mr. MacKenzie, who was 45 years of age, had been in the service of the company for over 30 years, and about seven years ago was transferred from the head office in Edinburgh to Glasgow.

Mr. Thomas Gillott, who died at Eastwood, Nottinghamshire, on December 8, aged 84 years, was well known in the iron and steel industry a quarter of a century ago. He entered the Railway Ironworks at Derby in the year 1861, and a short time later accepted a post at Messrs. Swingler's works in that town. Here Mr. Gillott had control and direction of the building of several important bridges on the Midland Railway and the goods warehouse at St. Pancras. In 1871 he was appointed chief engineer at the Farnley Ironworks, where he remained until 1884, when he became manager of the Butterley Company's works, Derby. He was associated with this company until his retirement in 1905. From 1891 until 1902 Mr. Gillott was a partner in the colliery firm of Locke & Company (subsequently Locke & Company, Newland, Limited), of Normanton. In 1881 he was awarded the Telford Premium for a paper contributed to the Institution of Civil Engineers on the basic open-hearth steel process.

Reports and Dividends.

Petters, Limited.—Interim dividend on the 7½ per cent. cumulative preference shares.

Cargo Fleet Iron Company, Limited.—Profit, £92,985; brought in, £182,917; debenture interest, £37,648; depreciation, £50,000; carried forward, £185,455.

Shotts Iron Company, Limited.—Credit balance, £3,382; brought in, £40,352; transferred from reserve, £25,000; depreciation, £25,000; carried forward, £38,290.

Consett Iron Company, Limited.—The directors have decided to pay one year's arrears, less tax, on account of arrears of dividend on the 8 per cent. preference shares.

Cleveland Bridge & Engineering Company, Limited.—Net profit, £24,532; brought in, £7,476; dividend of 3½ per cent., tax free, making 6 per cent.; to reserve, £5,000; carried forward, £7,499.

Allen West & Company, Limited.—Net profit, £29,291; brought in, £54,175; to depreciation reserve, £8,000; dividend at the rate of 8 per cent. per annum on the ordinary shares; carried forward, £61,642.

South Durham Iron & Steel Company, Limited.—Profit, £95,471; brought in, £138,007; debenture interest, £13,500; preference dividends, £18,000; depreciation, £40,000; dividend of 6 per cent. on the ordinary shares, £21,000; carried forward, £138,664.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—With the near approach of the Christmas holidays, business in the Cleveland iron market, so far as actual transactions are concerned, has been reduced to minimum proportions, few members of the trade attending except for the interchange of the usual greetings of the season. Chief interest in market circles is now almost entirely concerned with the all-important question of prices in the near future, and of the prospect of lower quotations. This latter is regarded by well-informed authorities as not unlikely, while an advance is considered improbable, the uncertainty of the position undoubtedly delaying buying on any extensive scale until more settled conditions are assured. Ironmasters, however, have no urgent need to press for business. Their current output is going steadily into consumption, and there are no heavy stocks to impose a strain on holders' financial resources. In the meantime, current quotations are unchanged, as follow:—No. 1 Cleveland foundry iron, 75s.; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; No. 4 forge iron, 71s. per ton.

Although cheap parcels of foreign hematite are being freely offered to Continental consumers, many of them continue to circulate inquiries for East Coast hematite, from which it may be inferred that they prefer the latter even at a higher price. Prices continue to advance, 81s. having been quoted and paid for contracts covering the first quarter of next year, whilst 6d. extra is quoted for No. 1 quality. On the North-West Coast, Bessemer mixed numbers are now quoted at 77s. to 78s. per ton at works.

LANCASHIRE.—Foundry pig-iron continues to be much the most active section of the Lancashire iron and steel markets, and sellers appear to be well satisfied with both the present position and future prospects. Prices remain firm at 77s. per ton for both Derbyshire and Staffordshire No. 3 iron, including delivery in the Manchester price zone. With regard to Scottish makes, most brands are now quoted for delivery at around 95s. per ton.

THE MIDLANDS.—Makers supplying this area are still experiencing a very good demand for foundry numbers, but it is chiefly against contracts already booked. The furnaces continue to be hard pressed to despatch supplies, and some of them are behind in deliveries. The present "zone" rates are 75s. for No. 3 Northants and 78s. 6d. for Derbyshire and North Staffordshire No. 3, delivered local stations.

SCOTLAND.—The feature of the pig-iron market has been the intimation by the Scotch Pig-iron Makers' Association of an advance in prices. Foundry and forge have been advanced by 2s. per ton, making the quotation now 78s. for No. 3 Scotch foundry, f.o.t. furnaces. Scotch hematite has also been advanced a shilling to 81s. delivered steelworks.

Finished Iron.

The prices recently quoted at Birmingham for bar iron have undergone no change, neither has the position been affected in any way during the current week. Orders for crown and nut and bolt iron continue to be very scarce, and the market is altogether poor for these grades of iron. Quotations for crown bars vary from £10 to £10 10s., and for nut and bolt iron from £9 to £9 7s. 6d. There cannot be any improvement with regard to business in nut and bolt iron while foreign material is available at such cheap rates as are ruling at present. The price for Staffordshire marked bars is £12 10s. at works. The mills making this iron continue to be fairly well occupied, and there is a reasonable chance of their having further commitments shortly.

Steel.

At Sheffield there is nothing of importance to report in the steel market. The demand for basic billets is well maintained, but for Siemens acid billets there is very little business moving. Wire rod imports appear to be increasing, and the market price of British soft rods has fallen to £8. To meet soft basic steel requirements two more furnaces have been put into operation. There is a welcome revival in the call for railway steel, both on home and export account, and for special and stainless steel there is a big demand. Motor steel specifications are somewhat smaller than of late. Market quotations:—Basic billets, soft, £7; semi-hard, £7 12s. 6d.; medium, £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d.; Siemens acid billets, £9 10s.; basic wire rods, soft, £8; medium hard, £9 15s. to £10; hard, £10 10s. to £11; acid, £12 5s. to £12 10s. The tinplate market continues steady, with quotations ruling at 18s. 9d. to 19s. basis, net cash f.o.b. Welsh ports.

Scrap.

Demand for all qualities of foundry scrap metal continues limited in volume, with prices generally irregular. At Middlesbrough the foundries are quiet, but no further break in prices has occurred, good ordinary heavy cast iron being still quoted at 62s. 6d. per ton, with only a slow demand. There is, however, a fair market for machinery quality, which is comparatively firm at 66s. 6d. In the Midlands there is a better demand for heavy cast-iron scrap than for the other qualities. For heavy machinery cast-iron scrap 70s. is the general price offered, with ordinary heavy metal at 65s. and light cast-iron scrap at 60s. In Scotland the market for cast-iron scrap is quiet, and prices are a shade weaker. Machinery quality is quoted at 68s. to 70s., ordinary 63s. to 65s., and light cast-iron scrap 60s., all per ton delivered f.o.t. at consumers works.

Metals.

Copper.—Conditions in the markets for base metals have been on a subdued scale of late, and during the ensuing holiday period few changes of importance can be anticipated. The November copper statistics, which are expected to be available shortly, may disclose conditions which will induce consumers to depart from their present attitude of buying on a hand-to-mouth scale only.

Closing quotations are:—

Cash.—Thursday, £68 16s. 3d. to £68 17s. 6d.; Friday, £69 to £69 2s. 6d.; Monday, £69 1s. 3d. to £69 3s. 9d.; Tuesday, £68 10s. to £68 12s. 6d.

Three Months.—Thursday, £68 6s. 3d. to £68 7s. 6d.; Friday, £67 17s. 6d. to £68; Monday, £67 17s. 6d. to £68; Tuesday, £67 10s. to £67 12s. 6d.

Tin.—Anticipation of an improvement in the outlook was responsible for a sharp recovery in tin values at the week-end close, the cash price advancing to £185 17s. 6d. per ton, an improvement of no less than £6 10s. per ton on the day. There is a growing belief that the Tin Producers' Association's scheme for holding up part of the tin ore at the smelters will ultimately be superseded by a plan for restricting output.

Official closing prices:—

Cash.—Thursday, £179 5s. to £179 7s. 6d.; Friday, £185 15s. to £186; Monday, £189 to £189 5s.; Tuesday, £186 to £186 5s.

Three Months.—Thursday, £182 7s. 6d. to £182 10s.; Friday, £188 15s. to £189; Monday, £192 5s. to £192 10s.; Tuesday, £189 5s. to £189 10s.

Spelter.—This section of the market on the whole has presented a firmer appearance. Some large buying orders have appeared on the market, and sellers have not been particularly willing to negotiate. At the same time, business with consumers remains disappointing.

Daily quotations are:—

Ordinary.—Thursday, £20; Friday, £20 2s. 6d.; Monday, £20 2s. 6d.; Tuesday, £20 1s. 3d.

Lead.—A steady tone has characterised this metal. Messrs. Henry Gardner & Company, Limited, state that, although buying by consumers is of a hand-to-mouth nature, the quantities taken are considerable, and prospects appear quite favourable, apart from the generally idle conditions by which most commodities are surrounded.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £21 10s.; Friday, £21 10s.; Monday, £21 10s.; Tuesday, £21 7s. 6d.

Students' Corner.

Q.—What is meant by explosive matter?

A.—When molten iron comes into contact with rust, or moisture, it is equal to putting a lighted match to gunpowder. Rust contains combined water which would be freed at a pouring temperature of iron. Moisture, or water, with its great expansion to steam, will cause immediate explosions, and the molten metal would fly in all directions.

Q.—Feeding rods during the operation of feeding often are encrusted with metal from the feeding basin. Can this be prevented?

A.—Yes. A moulder who allows the feeding rod to become encrusted and remain so, may be termed a dirty feeder in a two-fold sense. If he does not know how to keep the rod clean, he does not know how to feed a casting. With the judicious use of a "rapper" (*i.e.*, a piece of iron) the feeding rod can, during the process of feeding, be kept perfectly clean. A moulder who knows how to handle the feeding rod never allows it to be clogged, or spends his energy in lifting continually up, besides the feeding stalk will become choked up, consequently, not properly fed, hence the result will be a liquid shrinkage hole in the casting.

Q.—Can some examples be given of rod feeding?

A.—In the absence of sketches this is not very easy, but if we again take as a simple example the 12-in. cube we now know where the depression and spongy part is located. To feed that part solid in grey iron, a feeding stalk, or neck, should be made in the top-box-part, in the centre of the top of the casting; it should not be less than 4 in. dia., or about that area if square. A feeding basin above the feeding stalk should be about 10 in. area by 6 in. deep, the feeding rod should not be less than $\frac{3}{8}$ in. round, and the time of feeding should be from 10 to 20 minutes. The difference in the time of feeding is accounted for in the temperature when poured, and composition of the iron. When the mould is cast and the feeding basin is nearly full of metal, the feeding rod, after being heated, is lowered gently through the feeding basin and stalk into the casting, about a third of the way down, *id est*, about 4 in. into the casting. The feeding rod is now in the area where the depression and porous cavity exists. The feeding rod should be now worked up and down slowly all around the area of the feeding stalk or neck. By this means all the available liquid metal in the feeding basin is utilised. When commencing to feed, the top of the metal in the feeding basin should be covered with dry sand, or dry blacking, or, perhaps what is best and cheapest, a mixture of both. This covering on the top of the basin will conserve, or prolong, the fluidity of the metal, and will be no deterrent to the action of the feeding rod, but rather a help, as it will assist in keeping the feeding rod clean, and also prevent it from burning away quickly.

The above is a simple process of feeding by rod. It is best, whenever possible, to eliminate rod feeding and substitute head feeding, but it is not always convenient and economical to do so. But whenever rod feeding is employed, care and judgment is necessary to guard against insufficient feeding and dry feeding. In other words, underfeeding and overfeeding.

BEDWAS NAVIGATION FOUNDRY COKE

(Produced from the world-famous Bedwas Coking Coal.)

The British Benzol & Coal Distillation, Ltd., beg to announce that their new Woodall-Duckham Plant at Bedwas is now in operation.

Enquiries are invited from all those interested in high-grade Foundry and Furnace Coke.

S. INSTONE & CO., LTD.,
Sole World Sales Agents,
Baltic House, CARDIFF.

Agents for the Midlands :
J. C. ABBOTT & CO., LTD.,
Lloyds Bank Chambers,
New Street, BIRMINGHAM.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.

WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.

JAMES & RONALD RITCHIE, LTD.,

Telephone : 52 & 53. **MIDDLESBROUGH.** **Telegrams : "Ritchie, Middlesbrough."**

NETHERTON IRON

AND

N.B I.C BARS

(SOUTH STAFFORDSHIRE MARKED BAR—LION BRAND).

IN ALL QUALITIES, GRADES, SIZES AND SECTIONS.

ALSO MADE INTO

CRANE CHAINS, SLINGS, FORGINGS, Etc.

N. HINGLEY & SONS, LTD.

NETHERTON IRONWORKS, **DUDLEY.**

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	68	10	0
Three months	67	10	0
Electrolytic	82	10	0
Tough	75	5	0
Best selected	75	15	0
Sheets	110	0	0
India	90	10	0
Wire bars	83	15	0
Do. Jan.	83	15	0
Do. Feb.	83	15	0
Ingot bars	83	15	0
H.C. wire rods	85	12	6
Off. av. cash, November	69	8	4 5/16
Do., 3 mths., November	68	19	3 1/16
Do., Sttlmnt., November	69	8	5 3/16
Do., Electro, November	82	19	9½
Do., B.S., November	75	16	11½
Do., wire bars, November	83	15	5 3/16
Aver.spot price,copper, Nov.	69	8	4 5/16
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11½d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	12½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	11½d.
Wire	10 7/16d.
Rolled metal	10½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	186	0	0
Three months	189	5	0
English	186	15	0
Bars	192	0	0
Straits	192	5	0
Australian	191	10	0
Eastern	192	5	0
Bancs	100	0	0
Off. av. cash, November	180	13	7 2/7
Do., 3 mths, November	183	12	10 2/7
Do., Sttlmt., November	180	13	9½
Aver. spot, November	180	13	7 2/7

SPELTER.

	£	s.	d.
Ordinary	20	1	3
Remelted	18	15	0
Hard	17	5	0
Electro 99.9	22	10	0
English	20	10	0
India	18	10	0
Zinc dust (Nom.)	31	10	0
Zinc ashes	6	10	0
Off. aver., November	21	2	0 5/7
Aver., spot, November	20	17	0 5/7

LEAD.

	£	s.	d.
Soft foreign ppt. —	21	7	6
English	22	15	0
Off. average, November	21	12	7 1/13
Average spot, November	21	12	5 5/7

ZINC SHEETS, &c.

Zinc sheets, English	30	0	0
Do. V.M. ex-whf.	28	0	0
Rods	34	0	0
Boiler plates	26	10	0
Battery plates	27	0	0

ANTIMONY.

Special brands, Eng.	48	15	0
Chinese	31	0	0
Crude	19	10	0

QUICKSILVER.

Quicksilver	22	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£11 10 0
75%	£19 0 0
Ferro-vanadium—	
35/50%	12/10 lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/2 lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%	£16 0 0
Ferro-tungsten—	
80/85%, c. fr.	3/1½ lb.
Tungsten metal powder—	
98/99%	3/4½ lb.
Ferro-chrome—	
2/4% car.	£30 10 0
4/6% car.	£23 10 0
6/8% car.	£22 15 0
8/10% car.	£21 10 0
Ferro-chrome—	
Max. 2% car.	£33 10 0
Max. 1% car.	£39 0 0
Max. 0.70% car.	£41 0 0
70%, carbonless	11d. lb.
Nickel—99% cubes, or pellets	£175 0 0
Ferro-cobalt	9/6 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/7 lb.
Ferro-manganese (net)—	
76/80% loose	£12 10 0
76/80% packed	£13 10 0
76/80%, export	£13 0 0
Metallic manganese—	
94/96%, carbonless	1/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	6	6	to 3	7	6	
Bundled steel and shrngs.	3	3	0	to 3	6	0	
Mixed iron and steel	3	3	0	to 3	4	0	
Heavy cast iron	2	17	6	to 2	18	6	
Good machinery for foundries				3	2	6	
Cleveland—							
Heavy steel				3	3	6	
Steel turnings				2	16	6	
Cast-iron borings				2	13	0	
Heavy forge				3	15	0	
W.I. piling scrap				3	10	0	
Cast-iron scrap	3	2	6	to 3	6	6	
Midlands—							
Ord. cast-iron scrap				3	5	0	
Heavy wrought				3	17	6	
Steel turnings	2	2	6	to 2	5	0	
Scotland—							
Heavy steel				3	10	0	
Cast-iron borings				2	12	6	
Wrought-iron piling				3	19	0	
Heavy machinery				3	8	6	

London—Merchants' buying prices delivered yard.

Copper (clean)	61	0	0
Brass	42	10	0
Lead (less usual draft)	19	0	0
Tea lead	15	0	0
Zinc	14	0	0
New aluminium cuttings	65	0	0
Braziery copper	55	0	0
Gunmetal	54	0	0
Hollow pewter	132	0	0
Shaped black pewter	98	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	75/-
Foundry No. 3	72/6
Foundry No. 4	71/6
Forge No. 4	71/-
Hematite No. 1	79/6
Hematite M/Nos.	79/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/-
,, d/d Birm.	93/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	74/6
,, No. 3 fdry.*	78/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—
*d/d Black Country dist.	
Scotland—	
Foundry No. 1	80/6
,, No. 3	78/-
Hem. M/Nos.	81/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge.	72/-
,, fdry No. 3	76/-
E.C. hematite	88/6
W.C. hematite	90/-
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron ; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.				10	15	0
Nut and bolt iron	9	0	0 to	9	7	6
Hoops				11	0	0
Marked bars (Staffs) f.o.t.				12	10	0
Gas strip				11	0	0
Bolts and nuts, ¾ in. × 4 in.				15	5	0
Steel—						
Ship plates	8	12	6 to	8	17	6
Boiler plts.	9	12	6 to	10	10	0
Chequer plts.				10	12	6
Angles				8	2	6
Tees				9	2	6
Joists				8	2	6
Rounds and squares, 3 in. to 5½ in.				9	2	6
Rounds under 3 in. to ⅜ in. (Untested)				8	2	6

and upwards

Flats—8 in. wide and over	8	7	6
,, under 8 in. and over 5 in.	8	12	6
Rails, heavy	8	10	0
Fishplates	12	10	0
Hoops (Staffs)	9	15	0
Black sheets, 24 g.	10	0	0 to 10 5 0
Galv.cor.shts., 24g.	12	12	6
Galv. fencing wire, 8g. plain	12	0	0
Billets, soft	6	2	6 to 6 12 6
Billets, hard	7	10	0 to 8 0 0
Sheet bars	6	0	0 to 6 5 0
Tin bars	6	0	0 to 6 5 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/4
Sheet to 10 w.g.	1/5
Wire	1/6
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bessemer billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents
Iron bars, Phila.	2.12
Steel bars	1.90
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.75
Sheets, galv., No. 24	3.40
Sheets, blue an'l'd, No. 13	2.35
Wire nails	2.40
Plain wire	2.40
Barbed wire, galv.	3.05
Tinplates, 100-lb. box	$5.35

COKE (at ovens).

Welsh foundry	32/6 to 35/-
,, furnace	27/6 to 32/6
Durham and Northumberland—	
,, foundry	22/6
,, furnace	20/6
Midlands, foundry	—
,, furnace	21/6 and up

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		18/9
,,	28×20 ,,		38/-
,,	20×10 ,,		27/6
,,	18¾×14 ,,		19/6
C.W.	20×14 ,,		16/-
,,	28×20 ,,		34/-
,,	20×10 ,,		22/7½
,,	18¾×14 ,,		16/-
Terneplates	28×20		33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0	to	£7 10 0
Bars, hammered, basis	£17 10 0	to	£18 10 0
Bars and nail-rods, rolled, basis	£15 15 0	to	£16 15 0
Blooms	£10 0 0	to	£12 0 0
Keg steel	£32 0 0	to	£33 0 0
Faggot steel	£20 0 0	to	£24 0 0
Bars and rods dead soft, steel	£11 0 0	to	£14 0 0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.
Over ¼ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water	61½%	42½%
Steam	57½%	37½%

W.I. 10% extra.

Electrolytic Copper.

		£	s.	d.		
Dec. 12		82	0	0	No	change
„ 13		82	10	0	inc.	10/-
„ 16		82	10	0	No	change
„ 17		82	10	0	„	„

Tin (English ingots).

		£	s.	d.		
Dec. 12		180	10	0	dec.	15/-
„ 13		186	15	0	inc.	125/-
„ 16		190	0	0	„	65/-
„ 17		186	15	0	dec.	65/-

Spelter (ordinary).

		£	s.	d.		
Dec. 12		20	0	0	dec.	2/6
„ 13		20	2	6	inc.	2/6
„ 16		20	2	6	No	change
„ 17		20	1	3	dec.	1/3

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Dec. 12		68	16	3	inc.	3/9
„ 13		69	0	0	„	3/9
„ 16		69	1	3	„	1/3
„ 17		68	10	0	dec.	11/3

Standard Tin (cash).

		£	s.	d.		
Dec. 12		179	5	0	dec.	10/-
„ 13		185	15	0	inc.	130/-
„ 16		189	0	0	„	65/-
„ 17		186	0	0	dec.	60/-

Zinc Sheets (English).

		£	s.	d.		
Dec. 12		30	0	0	No	change
„ 13		30	0	0	„	„
„ 16		30	0	0	„	„
„ 17		30	0	0	„	„

Lead (English).

		£	s.	d.		
Dec. 12		22	15	0	No	change
„ 13		22	15	0	„	„
„ 16		22	15	0	„	„
„ 17		22	15	0	„	„

Exports of Iron Castings in November and the eleven months 1929, compared with November and the eleven months 1928.

——	November, 1928.	November, 1929.	Eleven months, 1928.	Eleven months, 1929.	November, 1928.	November, 1929.	Eleven months, 1928.	Eleven months, 1929.
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, grates, etc., cisterns, baths, etc., and cooking and washing boilers—								
To Argentine Republic	169	185	1,691	1,816	7,406	5,922	68,786	81,309
„ British South Africa	464	430	3,295	3,316	14,610	15,569	115,081	119,567
„ „ India	185	193	1,363	1,569	6,697	8,555	57,910	63,164
„ Australia	51	75	575	697	3,653	4,578	39,979	40,711
„ New Zealand	131	148	1,682	1,323	7,448	8,618	88,308	80,819
„ Other Countries	1,064	1,231	8,663	9,777	48,849	57,172	404,590	449,679
Total	2,064	2,262	17,269	18,498	88,663	100,414	774,654	835,249
PIPES AND FITTINGS—CAST—								
To Argentine Republic	950	1,820	8,834	22,838	7,773	17,478	87,821	213,890
„ British South Africa	336	1,147	4,924	7,407	5,302	11,963	70,456	90,927
„ „ India	495	362	7,176	3,902	7,019	4,462	97,314	53,607
„ Straits Settlements and Malay States	1,927	1,079	15,885	19,055	17,217	9,963	141,865	143,087
„ Ceylon	53	138	3,324	2,061	874	1,350	31,250	20,706
„ Australia	1,167	386	9,880	3,478	9,362	5,327	102,256	41,155
„ Other Countries	6,026	8,697	52,720	66,347	64,195	90,774	671,866	774,094
Total	10,954	13,629	102,743	125,088	111,742	141,317	1,202,828	1,337,466
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	551	546	4,368	4,533	20,746	19,666	165,709	161,256
„ Enamelled	82	82	734	884	7,318	7,607	70,156	79,126
CASTINGS, in the rough—								
Iron	89	108	1,459	1,396	3,269	4,591	47,071	51,400
Steel	108	245	691	1,375	4,901	9,605	29,684	54,478

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
19, ST. VINCENT PLACE, GLASGOW.
ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATION VACANT.

WANTED, Manager for foundry in Midlands producing small grey-iron repetition castings; must have thorough practical and technical knowledge, also up-to-date experience of machine moulding; good position for right man; must be young, energetic and capable.—State age, experience and salary required.—Box 394, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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